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ABSTRACT

This curriculum guide was designed to give students at the secondary level an awareness of Alaska's wetlands and the fish and wildlife that live there. The guide is divided into the following sections which include related learning activities: (1) definition and location of wetlands; (2) wetland functions in energy flow and ecological balance; (3) humans and wetlands, including Alaska Natives' approach to using wetland resources contrary to pollutions produced by industries; (4) issues, problem-solving, and action projects for wetland environment conservation; and (5) migratory birds and wetlands. Each learning activity consists of objectives, methods, background information, needed materials, procedures, information about combining with related academic subjects, and use of specific student skills. Suggestions for student evaluation and extended learning activities are included. A glossary and additional resources are also included. This guide contains many illustrations and maps. (LP)

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WETLANDS & WILDLIFE

Alaska Wildlife Curriculum

Junior & Senior High Teacher's Guide 7-12

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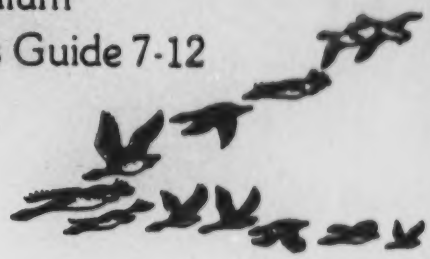

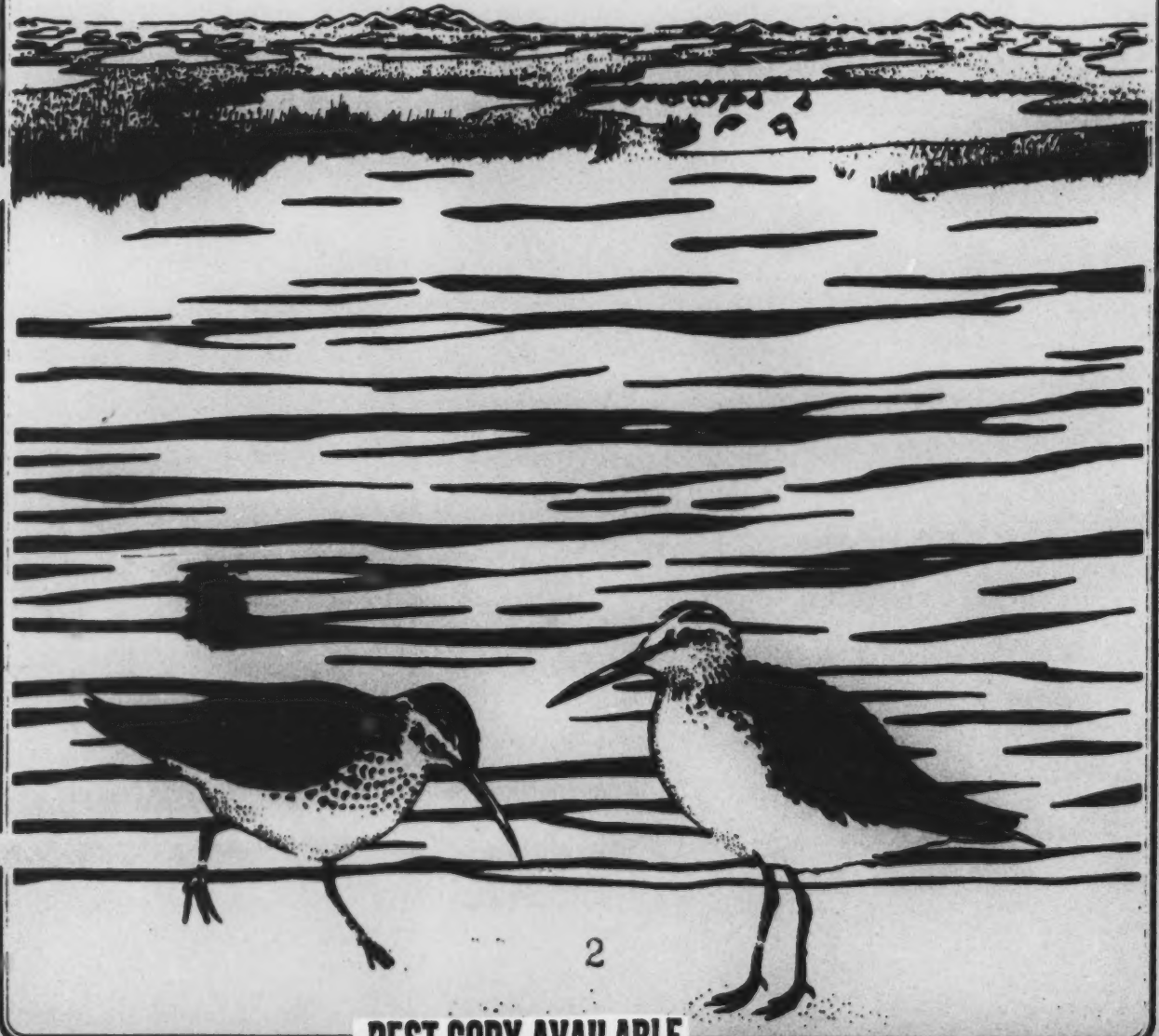

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INTRODUCTION

" looking is one of life s great pleasures. To be aware of the light and line and color around you, to look long and thoughtfully at something, to read in a shorebird s plumage the marks of wind and water and time, is one of humankind s gifts. Simply being in a wetland offers us vast opportunities to see."

Peter Steinhart
Tracks in the Sky

In 1984, the Alaska Department of Fish and Game developed and distributed an Alaska Wildlife Week curriculum packet with a wetlands theme. Six years later, the department has been joined by the U.S. Fish and Wildlife Service in the preparation of revised and updated curriculum materials. Activities from the original 1984 materials have been combined with those developed for the U.S. Fish and Wildlife Service's Teach About Geese curriculum, which addresses the specific issue of the decline of arctic-nesting geese populations on the Yukon-Kuskokwim Delta. The final unit of this teacher guide consists of teaching activities about migratory birds and their management.

The Junior and Senior High Unit consists of the following:

Teacher Information Manuals (Parts I and II)
Teacher's Guide
Energy Flow in an Alaska Wetland poster
Energy Flow Game
Field Trip Manual
Wetland Cards
Brant for the Future Gameboard

In addition, a packet of supplementary brochures about water and wetland topics has been sent to each school for use as reference materials.

You may use the activities or entire units throughout the year as they best fit into your teaching plans. A range of activities are included to give your students an awareness of Alaska's wetlands and the fish and wildlife that live there, the knowledge to understand the complex interconnections found in wetlands, and finally the decision-making skills for assuming personal responsibility for involvement in issues affecting wetlands and wildlife.

Activities have been designed for use in a variety of subject areas, including science, mathematics, social studies, language arts, art, and bilingual/bicultural studies.

With these activities, Alaskan educators can make lessons relevant to students throughout urban and rural Alaska. Moreover, students will have an immediate impact on the conservation of the natural resources which form the basis of our economics, recreation, and culture.

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Unit 1 — What Is A Wetland?

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Waterlogged Worlds 3
Students brainstorm words associated with wetlands, review definitions of wetland words and communicate them to the class through pantomimes or "raps," and create a mural depicting an Alaska wetland area.

Soaker Tester 20
Students perform experiments with different soil types by testing the amount of water each will hold. They summarize their results in a bar graph.

Locating Local Wetlands 24
Students locate wetlands on maps and aerial photographs and make interpretations by filling out a worksheet.

WATERLOGGED WORLDS

Objectives

Students will:
1. Recognize that a diversity of wetlands occur in Alaska.

2. Be able to describe at least two characteristics of five different kinds of wetland areas.

Method

Students will brainstorm words associated with wetlands, review definitions of wetland words, and communicate them to the class through **pantomimes** or "raps," and **create a mural** depicting an **Alaska wetland** area.

Background

Wetlands are transitional areas between land and deep water. They include the marshy edges of ponds, lakes, and streams as well as a variety of areas covered by shallow water or underlain by boggy, waterlogged soils (during the open water season). In short, wetlands are places where the water flow situation (or **hydrologic regime**) results in water remaining ponded or near the surface temporarily or permanently. Wetlands support plants adapted to life in wet areas. This lesson will focus on five common kinds of areas in Alaska that contain wetlands. (See the Teacher Information Manual, Part I, for more information about wetland definitions and Alaska wetland areas and types.)

Materials

- Wetlands Visual Vocabulary Cards - cut up
- container
- pencil
- 5 sheets of butcher paper
- colored markers - 5 sets of different colors
- 1 copy of each: "Waterlogged Worlds Fact Sheets", "Alaska Wetland Presentation Outline" and "Wetland Illustrations "
- class copies of "Wetland Bubble Puzzle"
- Teacher Answer key

Subjects: science, art, language arts, drama
Skills: comparing similarities and differences, drawing, group cooperation, listening, reporting, research, and role playing
Duration: two to three class periods
Group Size: 5 groups
Setting: classroom
Vocabulary: wetland, coastal, saltwater, marsh, bog, tundra
Topics: artistic expression, geography, habitat for wildlife, identification of plants and animals

Procedure

Activity 1: Visual Vocabulary*

1. Explain that wetlands include many areas that have waterlogged soils or are covered with shallow water. They are areas where water remains ponded or near the surface for part of the year. Only certain types of plants that can tolerate flooding or wet soil can grow there. Ask students to name local examples of areas they might consider wetlands according to this definition. List their ideas.

2. Explain to students that they will be working in groups. Divide students into 5 groups and begin with a round table activity warm-up. Give each group one piece of paper and one pen or pencil. Each group will be generating a list. The rules are:

1) writer may only write one word.
2) writer writes others' suggestions - not his/her own ideas.
3) writer passes paper and pencil to next person who then becomes the writer.

Each group has 90 seconds to write as many words as they can think of that are associated with the word wetland. Words can be verbs, nouns, or adjectives and can include activities by humans in wetlands (e.g. squish, berries, rain, damp, etc.). Words are legitimate as long as the association with wetlands can be justified by the writer. Have groups share their words and include any more ideas of local wetland areas to the list.

3. Have Wetland Vocabulary Cards cut, folded, and in a container ahead of time. Have groups take turns drawing a card from the container. Allow about five minutes for the group to prepare a mime to depict the wetland definition or a rap about it.

4. Groups of students then take turns pantomiming their definitions or rapping. Set a time limit of one minute per group. Other groups may earn points for guessing the correct wetland word being defined or described by the rap or individual students may guess after the group has completed their presentation.

* Adapted from Project WILD, Visual Vocabulary, Western Regional Environment Council, 1983.

Activity 2

1. Explain to students that Alaska has many wetlands of different kinds. Give examples such as marshes, bogs, muskegs, and "flats" areas along the coast. Tell them that they will be learning more about what a wetland is and about five kinds of areas in Alaska that have many wetlands: coastal areas, stream and river corridors, marshes, bogs, and tundra.

2. Explain to students that each group will become "experts" on these five kinds of areas and will share their findings with the rest of the class. It may be helpful to designate or let the group decide on specific roles for each member: procurement officer (gets materials or asks questions), facilitator (organizes group), spokesperson (organizes presentation), encourager (keeps group interactions positive), etc.

3. Groups will then work on creating a mural depicting their area. Have a materials table set up for one person from each group (the procurement officer) to

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obtain: one sheet of butcher paper, a different colored marker for each group member, "Waterlogged Worlds Fact Sheets," and "Wetland Illustrations." Have library books related to wetlands available: plant and animal field guides, picture books, etc. The wetland cards should be displayed or made available as well. Each group is to study and discuss the description of their area and develop an illustration that represents it.

4. All members within the group will present the illustration and choose a spokesperson to describe the major characteristics of their area. Each group member must contribute to the illustration and sign his/her name using the same color marker the entire time. Emphasis will be on group cooperation, accurate representation of their wetland area (less enthusiastic artists may want to label items or devise symbols), and explanation of at least two characteristics. Rules are:

1) Presentation must include a description of the area and two important characteristics of the area that contribute to the presence of wetlands.

2) All members must contribute to the mural with their specific color marker and sign it in that color.

5. Have groups make their presentation. Provide listeners with a presentation note-taking guide. Hang up wetland illustrations and discuss what is the same about the five areas. In what ways do they differ?

6. Look at the list of local wetland areas. Do they fit any of the five descriptions?

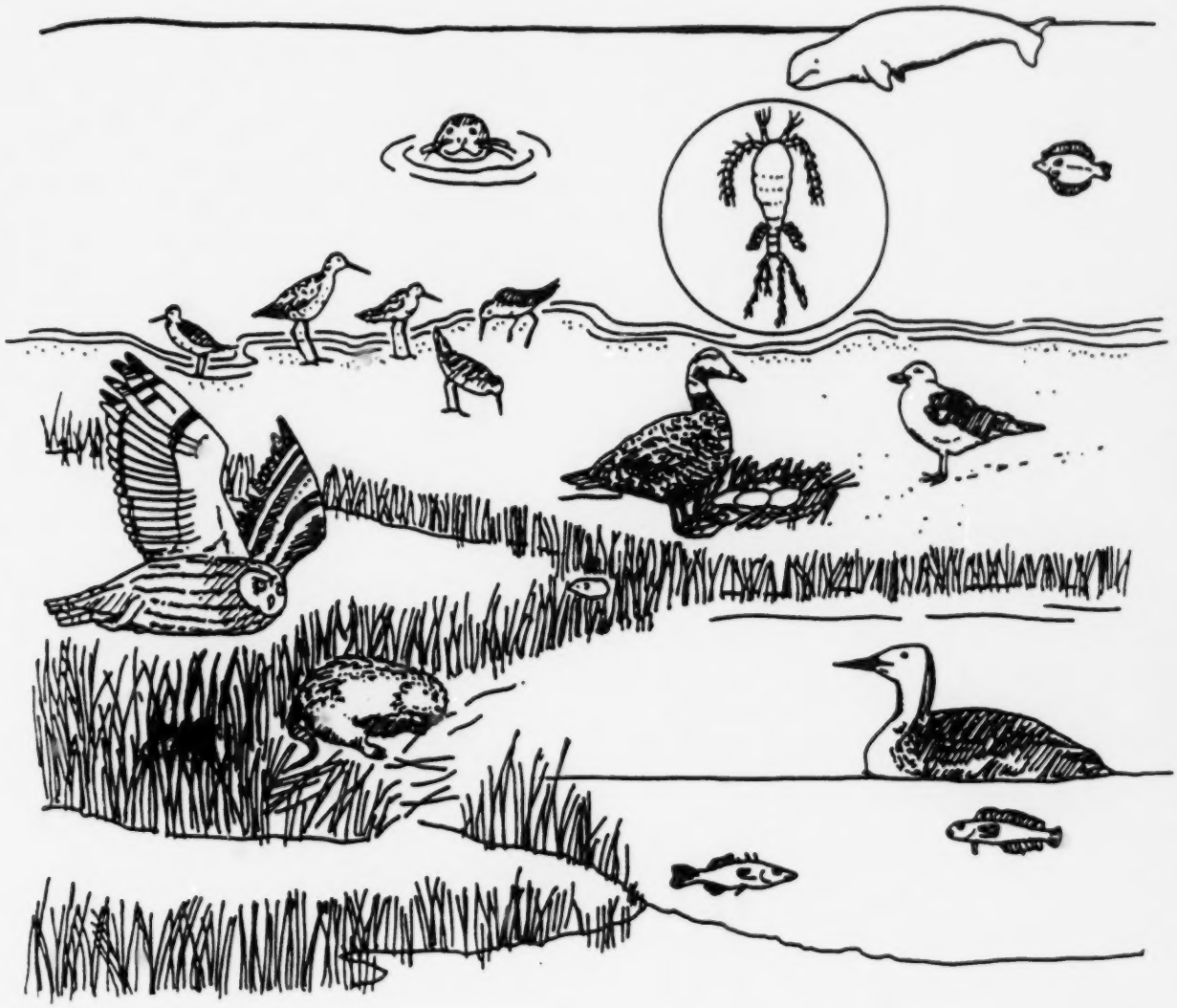
Evaluation

Students may earn a group and/or individual grade. Group grades may be given for group cooperation skill behaviors set up and explained to students ahead of time. Individual grades could be earned by (1) naming one or two characteristics of each wetland area and/or (2) completing the "Wetland Bubble Puzzle."

Extension

Advanced students may be interested in the process of classifying wetlands. Refer to the Appendix to the Teacher Manual, Part I, for information on classifications developed by Alaska ecologists. Contact the National Wetlands Inventory Program, U.S. Fish and Wildlife Service, 1011 East Tudor Avenue, Anchorage, AK 99503 for more information about wetland types in your area and maps.

COASTAL AREAS



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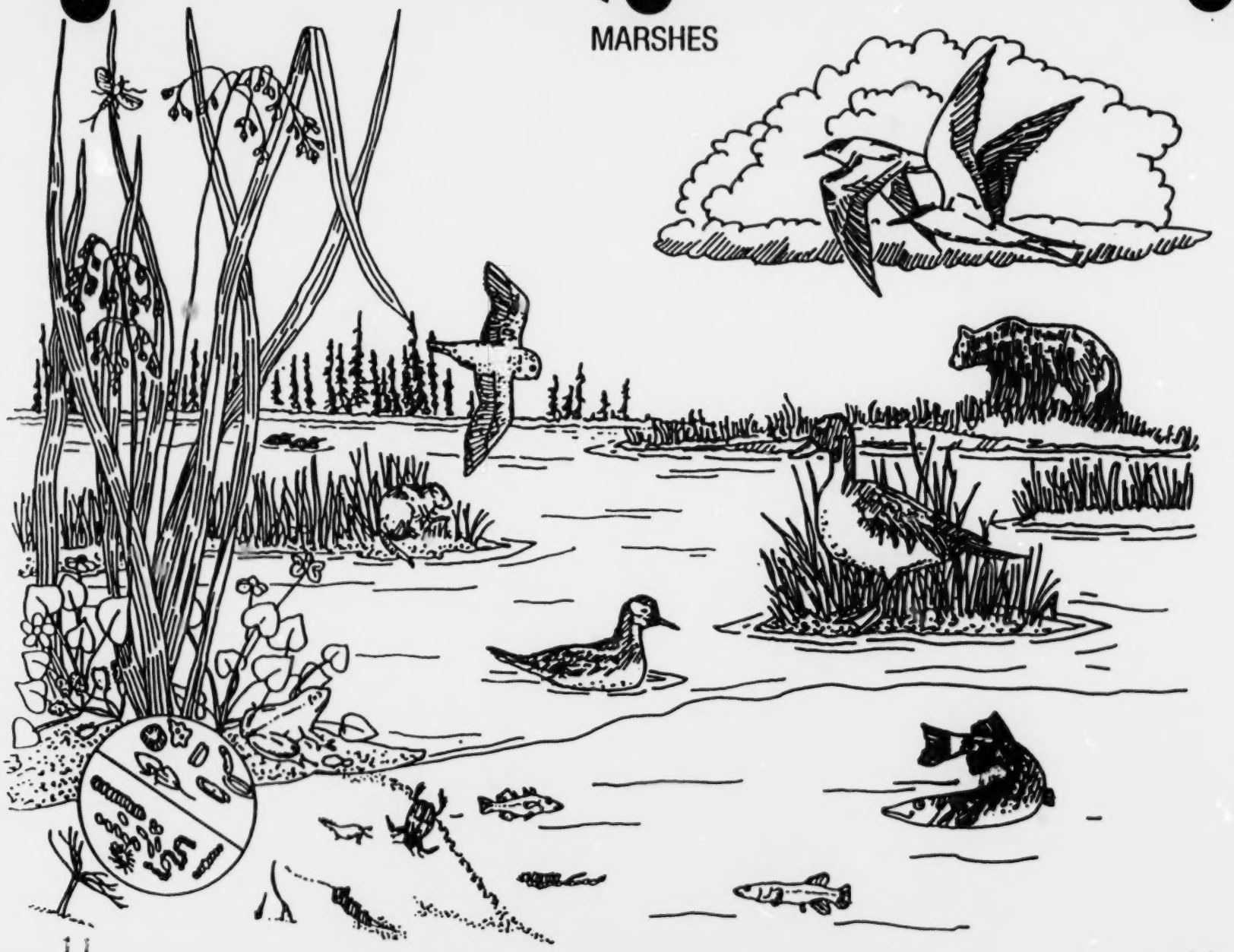
MARSHES



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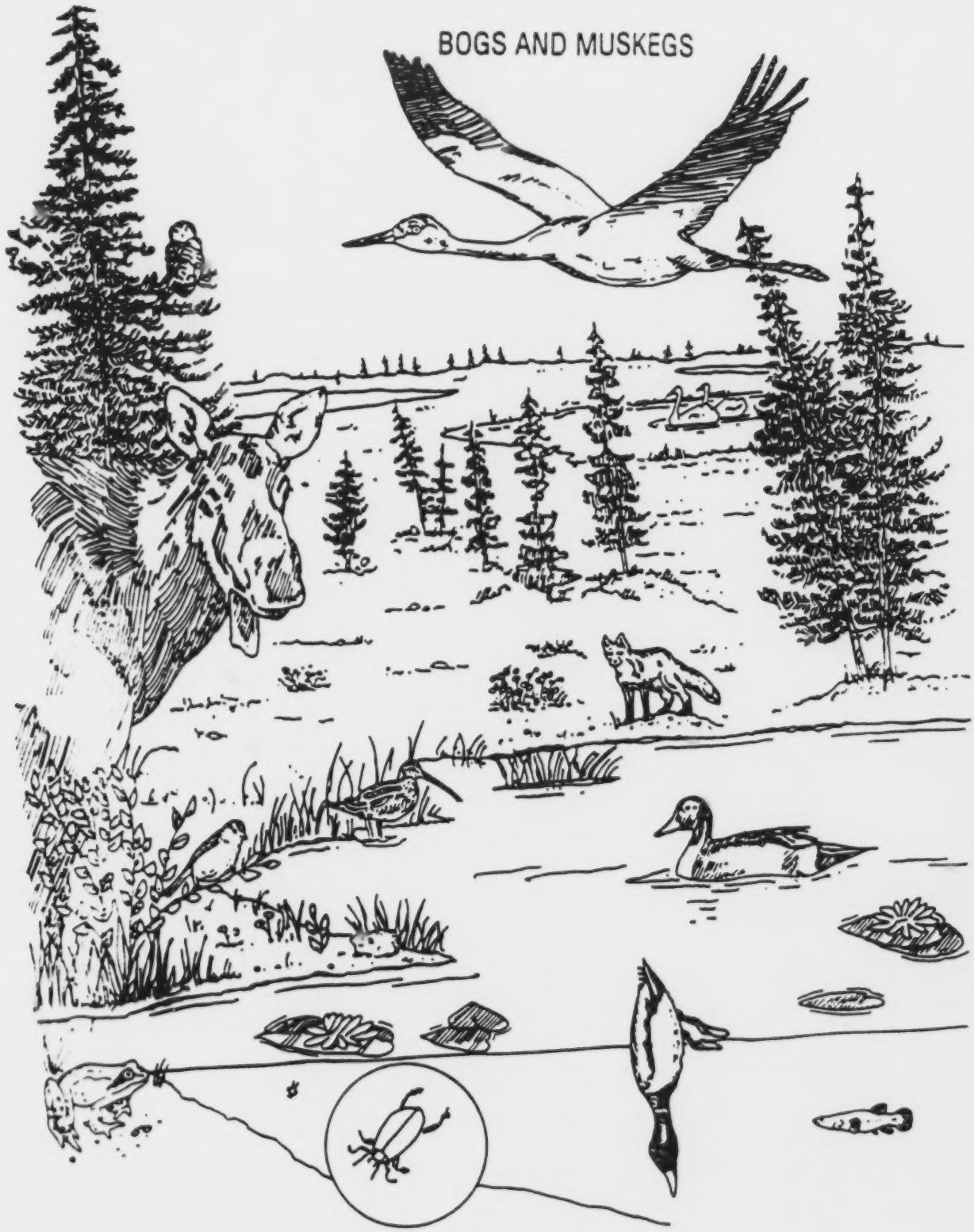

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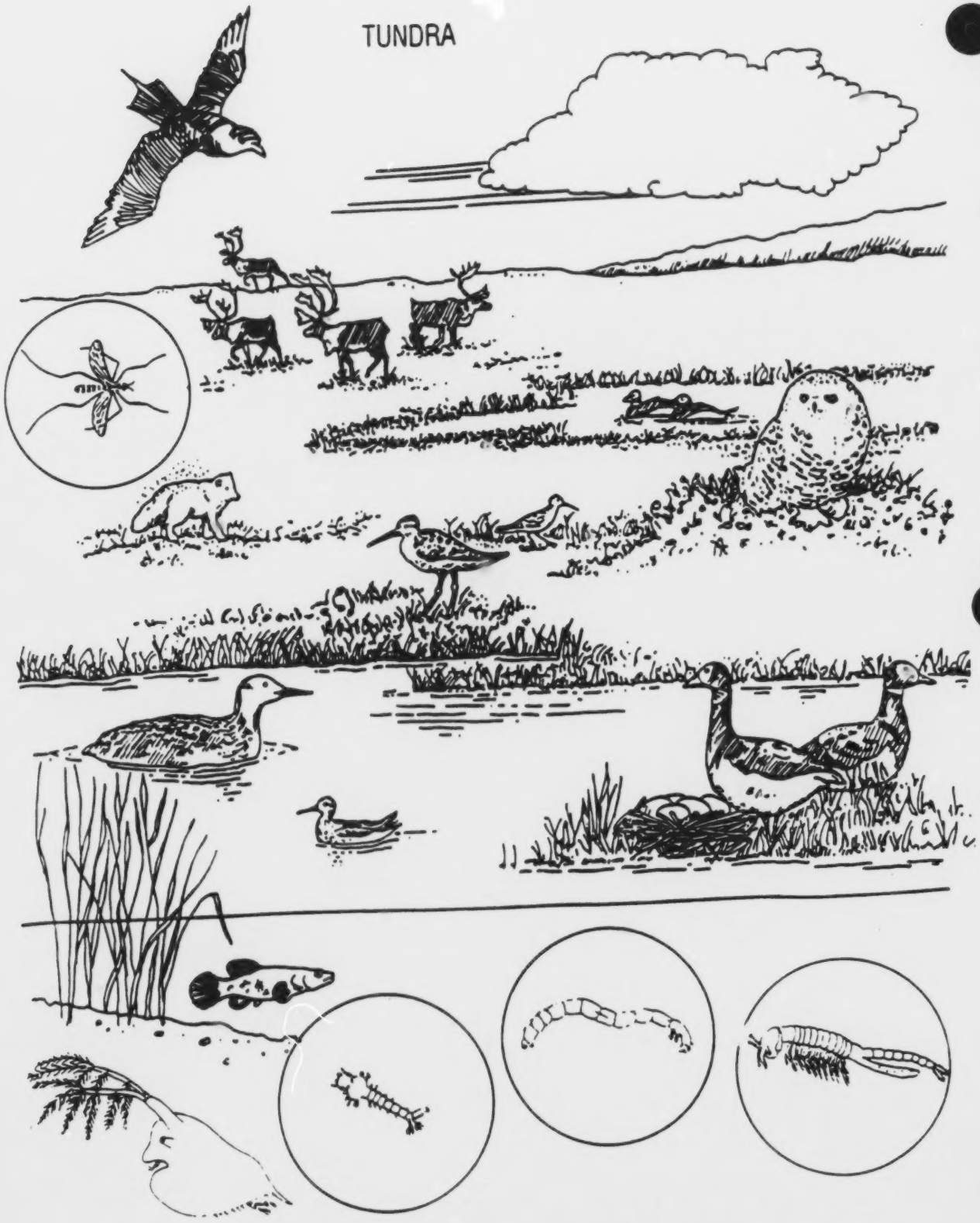

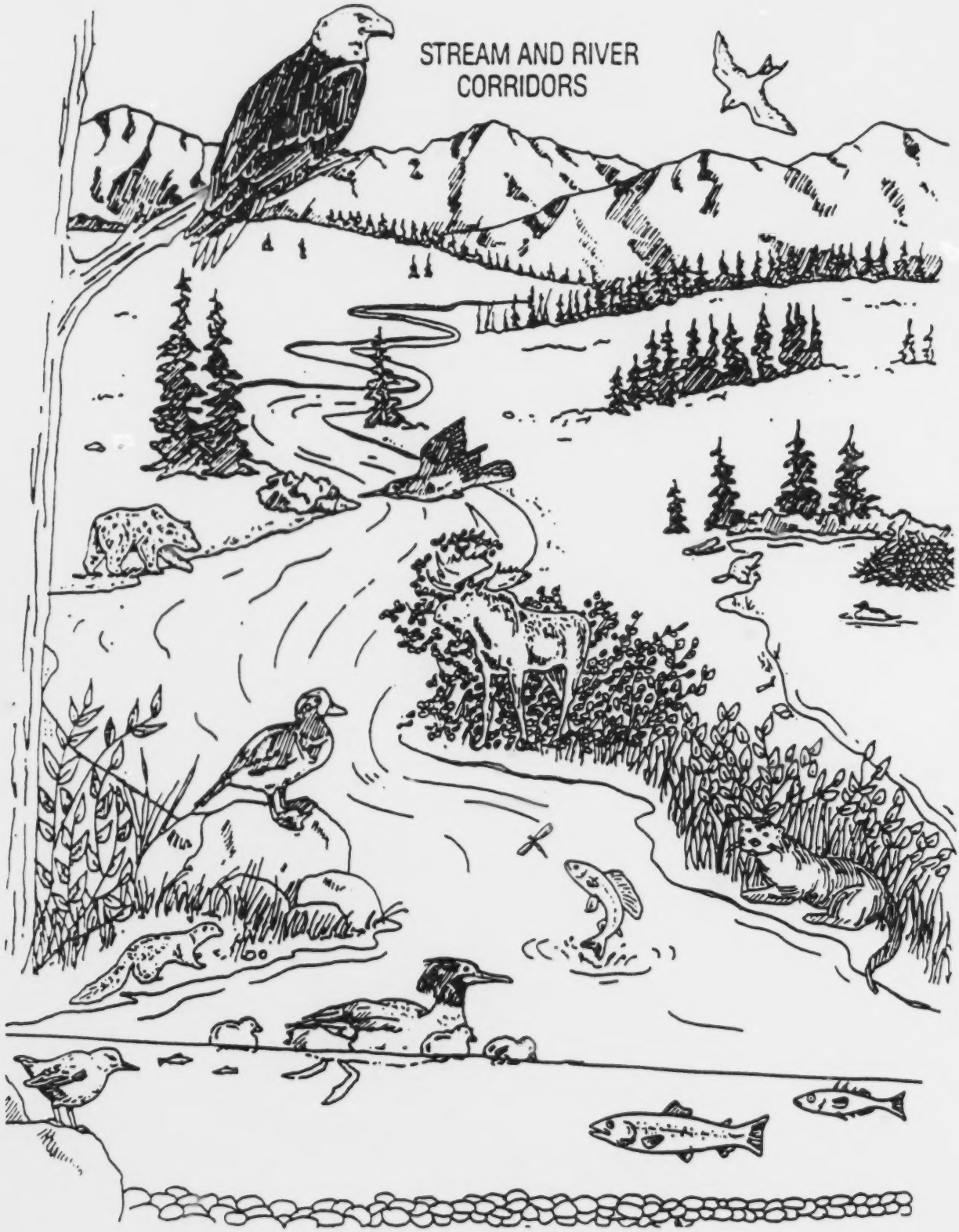

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Waterlogged Worlds Fact Sheet #1

Marshes

Imagine an area of buzzing mosquitoes, flitting dragonflies, and fluttering butterflies. Your picture probably has a pond or lake in it or perhaps a large flat, wet area. The plants that grow in marshy areas have adapted to live in shallow water.

What type of adaptations does a plant need to grow in shallow water? First, they have to have special roots that can do their work underwater - the work of bringing minerals and water into the plant and up to the stem and leaves. On land, the leaves do the work of capturing sunlight and carbon dioxide from the air to make food. The flowers do the work of attracting bees or flies to pollinate them. Not surprisingly, only a few plants have adapted to live completely submerged underwater where their leaves still get some sunlight and they are able to extract carbon dioxide from the water. Most other plants that live in shallow water are **emergent plants**, which means they have long, rigid stems that hold their leaves and flowers above the water's surface, or they have long stems and leaves and flowers that can float. Because of their different adaptations, plants can only grow in certain depths of water. Too deep and an emergent plant can't reach above to sunlight, air, and pollinators. Too shallow and submerged plants can't grow.

Lakes and ponds form in holes in the ground which collect water from rain or snow melt. In Alaska, many holes were formed as the glaciers gouged them while retreating. Some of these are now large, deep lakes. Other areas are marshes because they are flat and low-lying, so they collect and hold the water that drains off nearby ridges, hillsides, or mountains. Shallow-water marshy areas can be found throughout Alaska, some with distinct ponds and lakes and channels and some areas where it is difficult to determine which direction the water is slowly moving, if it is moving at all. The plants sort themselves out depending on how deep the water is and the water conditions to which they are best adapted. Thus, many ponds and lakes have rings of different types of plants around their edges.

Many animals depend on these types of wetlands for their food, water and shelter, or **habitat**. They are often ideal areas for birds to raise their young. Food, in the form of plants, invertebrates, and fish, is usually abundant for ducks and geese. Ducklings and goslings can hide among the emergent plants. Adult and young birds can swim to safety to escape hungry foxes who can't swim. The plants are good for building nests and nearby trees may have holes for nesting by some types of ducks. These watery worlds can be rich areas for fish and wildlife.

Many mammals also live here. Moose submerge themselves in shallow ponds to dig up plant roots. Mink, otter, muskrats, and beaver swim in the shallow water and also find food. Fish also find abundant insect food and young fish can hide among the plants. Fish can live in lakes year-round if the water is deep enough so it never freezes solidly.

Waterlogged Worlds Fact Sheet #2

Tundra

A winter visit to the Alaska tundra can be a cold and windy experience. During the winter, the tundra is very cold. In fact, winters are so cold and so long in some parts of the tundra that the ground remains frozen year round. The frozen ground is called **permafrost**. You won't find a nice stand of trees to get out of the wind because there are no trees on the tundra. Tundra is the place that is too cold and windy for trees to grow.

A visit to many tundra areas during summer is likely to be a soggy experience for your feet. After the snow thaws, water is everywhere on the mostly flat ground. Some tundra areas dry out eventually during summer, but flatter and lower areas others remain wet and are tundra wetlands. Even during spring and summer, the tundra remains windy and fairly cold. As the top layer of the ground slowly thaws out, it becomes soggy and wet. But if you dig down a short distance in many tundra areas in Alaska, you will reach ice or frozen ground. The top layer of the tundra stays soggy because water can't soak down into the ground past the permafrost.

How can anything live in tundra wetlands? Not surprisingly, any plants that do grow there are very short. They grow larger by spreading out, staying low to the ground where it is slightly warmer and less windy. They have to be specially adapted to have their roots frozen all winter and taking minerals from cold, soggy soils during summer.

Despite these hardships, plant life virtually explodes in tundra wetlands during summer. All the water provides the perfect habitat for — mosquitoes! In turn, the mosquitoes and other insects provide a large amount of food for birds. Many types of **water birds**, which are adapted to life in or near water, fly long distances to nest in the tundra and take advantage of the abundant insect food.

Other animals live in tundra wetlands only during summer. Caribou arrive from hillier areas to the south and raise their calves on the tundra. Wolves, arctic foxes, and arctic ground squirrels build dens and raise their young. Grizzly bears arrive after a long winter in their den.

Summers are short. By August, snow may fall and many of the birds and mammals begin moving south. Bears and ground squirrels dig new dens. Lemmings and other small mammals remain active in tunnels beneath the snow, feasting on plants stockpiled during the summer. Muskoxen and small groups of caribou remain to paw through the snow for food. Once again, the tundra becomes a cold and windy place.

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Waterlogged Worlds Fact Sheet #3

Stream and River Corridors

Warm April weather comes and the Yukon and Kuskokwim Rivers swell with ice. In June, heavy rain falls in Delta, and the Tanana River spreads out above its banks near Fairbanks, connecting ponds and sloughs. Warm July weather melts glaciers and all the streams fed by glaciers in Southeast and Southcentral Alaska rise and flood. Little rain falls in August and the rivers shrink, leaving behind rich muddy deposits on gravel bars, islands, and banks. Rivers and streams are always changing in response to the cycle of water that falls or doesn't fall to earth and the in response to temperatures that affects the melting or freezing of ice and snow.

Since rivers and streams can be depended upon to rise and fall, the area around the river that is flooded also changes. A zone on both sides of the river may be flooded at one time or another. These zones on each side of the river and the river itself are a **corridor** which may include many wetland areas, including ponds, lakes, marshes, and shrub and tree stands that get flooded.

Areas very close to the main channel of the river are frequently flooded while those far away are rarely flooded. Different plants live in different areas of the wetlands flooded by rivers, depending on how adapted they are to being flooded on a regular basis. Some plants adapted to being permanently wet live closest to the channels of the river. Some shrubs, such as alders and willows, can grow into large stands even when flooded frequently, and these stands provide **habitat** or food and cover for moose, bears, and a variety of birds. These animals often live and travel along these corridors where they can find everything they need for survival.

Wetlands along river corridors are especially important for fish. The wetland plants provide shelter and food for young, growing fish. As they slowly drain back into main channels, they can keep the pools of the river deep enough for fish to live in even during long periods when no rain falls.

Streams that flow into rivers act like sculptors. The action of their flowing water slowly tears down the stream banks. The smaller soil particles are deposited in calmer waters and new islands are formed. If you could observe a large river over a period of years, you would see it create a new landscape! As the landscape changes, so does the different places the plants can grow.

River corridors are dynamic. Everything that ends up in the stream is washed downstream. When trees lose their leaves or plants freeze and die along the edge, it all goes downstream. But when the rivers flood, they deposit soil and nutrients in the riverine wetlands.

Waterlogged Worlds Fact Sheet #4

Coastal Areas

When you visit the beach, the thing you cannot avoid noticing is the tide. The tide brings salt water higher and higher on the beach as it comes in and farther and farther out as it goes out. Did you ever think what it might be like to live in the place covered and uncovered by the tides? Or what it would be like to be a young salmon going to sea? After spending your whole life in fresh water you would meet the tide and the water would become saltier and saltier. If you could stay awhile near the mouth of the river, where the water was only a little salty, but not as salty as the ocean, it would be easier for you to get used to saltier and saltier water.

Many plants and animals live in areas along the coast in Alaska's **saltwater wetlands**. There are several different types of areas where the ocean meets the land. Wherever a stream or river meets the ocean, the salt water from the ocean mixes with the fresh water because fresh water is flowing out into the ocean and the ocean is coming back up the river every time the tide comes in. The places salt water and fresh water meet are called **estuaries**. Estuaries are rich places for life like the young salmon which spend a few weeks or months getting ready for life in the ocean.

Some estuaries have large areas of marshes and large sandy beaches or mudflats. These are the places that bird stop during their long migrations to and from Alaska because they find food and shelter there. Much of the life in the mudflats is beneath the surface where clams and worms live in burrows. The flocks of birds you see standing in shallow water and poking their long bills down into the water are digging for these hidden foods! Many birds stay and nest along the coast in or near saltwater wetlands.

Other parts of Alaska's coasts have long peninsulas or spits with shallow **lagoons** behind them. During summer, the lagoons provide shelter from the winds and waves for birds and fish.

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Waterlogged Worlds Fact Sheet #5

Bogs and Muskegs

Peat and **acid**. These are the two ingredients that make up Alaska's bogs and muskegs. Perhaps you have one near your home or school. Can you think of a wet, mossy place where it's hard to walk without sinking and only short trees live there? Maybe it's the place you go to pick blueberries or, if you live in Southeast Alaska, the place you go to get a pine Christmas tree.

Did you ever wonder why these areas are so much wetter than the surrounding forest? Bogs and muskegs usually start with a low spot or hole in the ground, often one gouged by a glacier when it melted. The low spot collected rain and snow and plants grew there. When plants died, the bacteria and fungi which **decompose** dead plants and animals began breaking them down. But where there are bogs and muskegs, the decomposers couldn't keep up. The dead plants piled up and soaked up water from rain and melted snow. Eventually the hole was filled with soggy mats of dead plants and a special kind of moss that loves soggy places. These mosses are the peat mosses and the soggy mats are called peat. (You may have used dried peat moss in your garden at home? Did you notice how much water it could soak up?)

The water in bogs is usually acidic. Peat mosses and other dead plants make acids which make it hard for other plants to live where they do. But Alaska bogs and muskegs contain many interesting plants. It takes a special kind of plant to live in a cold, wet place that is frozen part of the year. Watery bogs and muskegs are, of course, ideal places for insects, so birds often nest and perch on the edge of bogs and muskegs near their swarming food. Voles and mice also live there, making them good hunting places for hawks and owls.

Alaska Wetland Presentation Outline

Bog and Muskegs

Description:

Two characteristics that contribute to wetlands being present:

1. _____
2. _____

Coastal Areas

Description:

Two characteristics that contribute to wetlands being present:

1. _____
2. _____

Marshes

Description:

Two characteristics that contribute to wetlands being present:

1. _____
2. _____

Tundra

Description:

Two characteristics that contribute to wetlands being present:

1. _____
2. _____

Stream and River Corridors

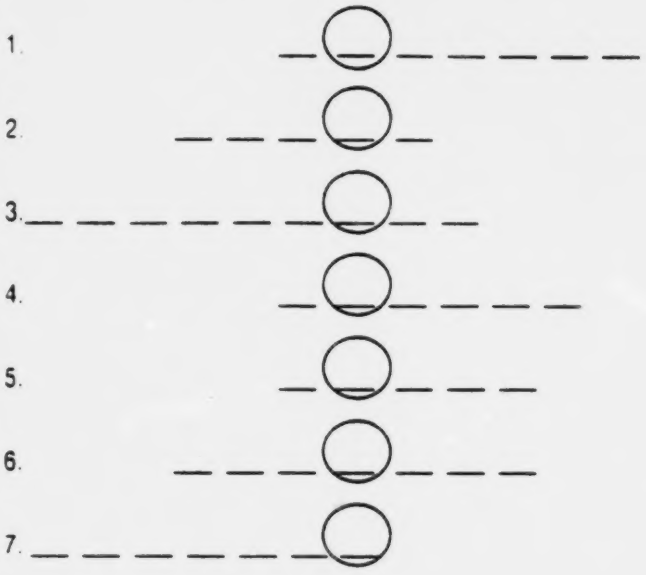
Description:

Two characteristics that contribute to wetlands being present:

1. _____
2. _____

Wetland Bubble Puzzle

Directions: Answer the clues by filling in the appropriate spaces. When you have filled in all the blanks, the circled letters will spell the mystery word.



1. A place that has waterlogged soils and is often covered with shallow water at least part of the year.
2. Water-lilies, horsetails, arrowheads, and grasses can be found in this kind of wetland area - especially around pond and lake edges.
3. Mudflats, salt marshes, and lagoons are examples of this kind of wetland area.
4. A place with cold winters, a short growing season, and no trees.
5. There is a lot of this in wetlands!
6. Most Alaska birds use many different wetlands when they do this during the spring and fall.
7. A place where freshwater from rivers and streams meet saltwater from the ocean.

Wetland Bubble Puzzle - Answer Key

Directions: Answer the clues by filling in the appropriate spaces. When you have filled in all the blanks, the circled letters will spell the mystery word.

1. w (e) t l a n d
2. m a r (s) h
3. s a l t w a (t) e r
4. t (u) n d r a
5. w (a) t e r
6. m i g (r) a t e
7. e s t u a r (y)

1. A place that has waterlogged soils and is often covered with shallow water at least part of the year.
2. Water-lilies, horsetails, arrowheads, and grasses can be found in this kind of wetland area - especially around pond and lake edges.
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Wetland Visual Vocabulary

DABBLING DUCKS	Ducks which use shallow marshes, ponds, and rivers and "tip up" to feed leaving only their tails above the water. They do not dive, they take off straight up into the air when startled. They are also called "puddle ducks."
ANADROMOUS FISH	Those fish which spend the greater share of their lives in salt water, but migrate into freshwater streams to spawn: salmon and some trout and char.
WATER CYCLE	The movement of water through the environment; evaporation from the ocean and the land, condensation as clouds and fog, precipitation as snow, ice, and liquid; and the eventual return of water to the sea by rivers and groundwater.
TIDES	The daily change in ocean level caused by the influence of the moon and the sun's gravity upon the earth. In Alaska, tides have four distinct phases
PRECIPITATION	Rain, snow or ice which falls from clouds. See activity "Water Cycle"
FLOOD	An unusually high water event caused by precipitation, tides, or storms. Floods can occur in all types of wetlands.
WATERFOWL	Ducks, geese, and swans.
SPAWNING	The act of producing or depositing eggs; usually refers to fish.
FOOD CHAIN	The transfer of energy from its primary source, the sun, to plants and on through a series of animals, with repeated eating and being eaten. For example, a green plant, a leaf-eating insect, and an insect-eating bird would form a simple food chain. Any one species is usually represented in several or many food chains.
ECOSYSTEM	A natural unit that includes living and nonliving parts interacting to produce a stable system in which the exchange of materials between the living and nonliving parts follows closed paths; all living things and their environment in an area of any size, with all linked together by energy and nutrient flow
CARNIVORUS PLANT	A plant that is adapted to capture and digest insects to supplement its diet of sugar produced by way of photosynthesis.
MIGRATION	The annual movements of birds or other animals, such as the movement of birds between their nesting areas and their wintering areas in spring and fall. Migrations may be cover very large distances or very short distances, depending upon the type of bird.
HYDRIC SOILS	Soils whose major characteristic is the presence of water; soils which retain water.
HYDROPHYTES	Water-loving" plants, ones growing in and very well-adapted to wet areas
HYDRO	Having to do with water; for example, hydroelectric power, hydrophobia

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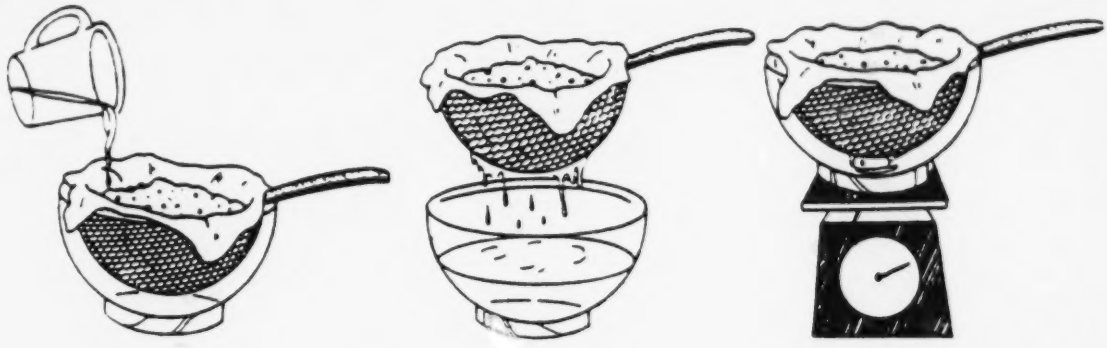
SOAKER TESTER



Objective

Students will find the water retention of five soil types and relate their findings to wetland soils.

Method

Students will perform experiments with different soil types by testing the amount of water each will hold. They will summarize their results in a bar graph.

Background

Wetlands serve as water storage areas that reduce flooding by soaking up excess water and slowly releasing it to streams. This experiment compares the ability of different soil types to retain water. The ability of soil to retain water depends on the size of soil particles. Larger particles, such as rocks, permit a more rapid passage of water; smaller spaces between silt and sand particles impede the passage of the water, contributing to the **waterlogged** nature of soils in wetlands. If you are able to use soils containing live **peat moss** in your experiments, water **retention** will be even greater — up to 15-23 times its dry weight — because of adaptations that allow mosses to "wick" water into their leaves and to absorb water into plant cells.

Even if the soil directly beneath a wetland is porous, it is possible that water will still not drain. Standing water can be caused by non-porous layers deeper than the soil layer. For example, permafrost may lie below a wetlands and cause an area to be saturated. In many areas of Alaska the finely ground glacial "flour" becomes compacted and prevents water drainage. Sometimes scientists must dig deep below a wetland to find the causes of their existence.

Materials

- funnel, cheesecloth
- bowl (large enough to hold sieve)
- scale, live moss, dried peat moss (found in any plant store, nursery or bog)
- sod (or soil sample near your home)
- sand (from a beach)
- rock or gravel, water
- measuring cup
- Soaker Tester Data Sheets - group copies

Subjects: science, math
Skills: analysis, drawing conclusions, graphing, interpreting data
Duration: one to two class sessions
Group Size: large or small group
Setting: classroom
Vocabulary: retention, peat moss, waterlogged

Procedure

1. Tell students that they will be working in groups testing different soil types for water retention and that each type relates to different land areas. Students should make predictions (based on what they know of each of the materials) concerning which material they think will best soak up water and record it on their Soaker Tester Data Sheet. Samples may be weighed in equal amounts ahead of time or students may weigh each sample while they are waiting for the water to soak through.

2. Show students how to use materials and collect data by demonstrating the steps for weighing one of the samples. Students should follow the directions for the experiment and record the data on their Data Sheet. Emphasize taking accurate weight measurements and accurate timing for each soak.

3. As a class or in their groups, have students organize their results in bar graphs or in a way that makes their data easily understood.

4. Ask students if their predictions were correct. Which of the materials would most likely be found in a wetlands? How did the materials rank from most water retained to least? Compare each group's data. If there are differences, what could account for them? Since the mosses are found in wetlands and hold the most water, what is one function of a wetland? (They soak up water and temporarily store it.) How might this function affect the surrounding land? (It may prevent flooding by releasing water gradually over time, some water may trickle through the soil and add to the groundwater supply.) What other factors besides differences in soil type might result in waterlogged soils? (Compacted glacial clay, permafrost.)

Evaluation

Organize the results of your data (individually or in your groups) in a bar graph or in a way that makes your data easily understood. Form a generalization relating the results of your bar graph with wetland areas.

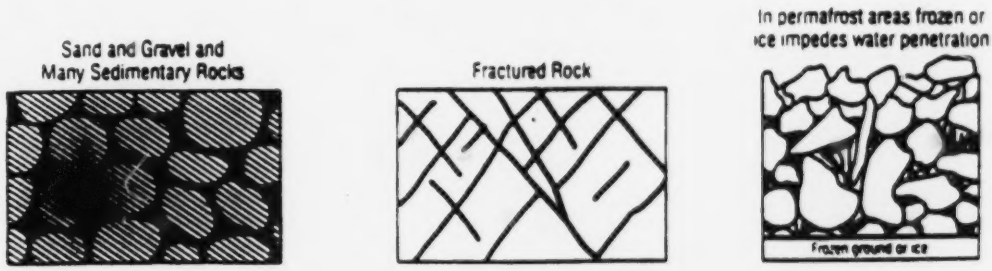
References

Hanging on to the Wetlands - Book I. Western Washington University.

Quinlan, Susan. 1988. Alaska Wildlife Week, Unit 6, "Alaska's Living Tundra, Permafrost Puzzles." Alaska Dept. of Fish and Game.

Extension

Have students do experiments that simulate permafrost by freezing wet soil in a pan (see Alaska Wildlife Week, Unit 6, "Alaska's Living Tundra, Permafrost Puzzles").



Examples of porosity of different materials

Soaker Tester Experiment Directions

1. Weigh out an equal sample of each material. Each of the five samples should weigh about the same.

2. Put the cheesecloth, sieve, and bowl together to make your Soaker Tester.

3. Take the sample of live moss. Put it in your Soaker Tester. Carefully weigh the Soaker Tester with the moss in it. Write down the weight in the proper space on your data sheet.

4. Add 1 cup of water and let the Soaker Tester and moss sit in the water for 3 minutes.

5. Take the sieve out of the bowl. Pour the water out. Some water may drop out of the sieve for a few seconds. BE SURE NOT to squeeze any water from the moss or the sieve.

6. Put the sieve back in the bowl. Weigh the Soaker Tester and moss again. Write down the weight in the proper space on your data sheet.

7. Repeat steps 3 through 6 using each of the other materials on the data sheet. Write down the weights you find in the proper spaces on the data sheet.

8. What is the weight of water each material soaked up? Find out by subtracting the number in column A from the number in Column B and write the result in Column C.

9. Does your data confirm or reject your prediction? Circle the appropriate response at the bottom of the Data Sheet and complete the statement.

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Soaker Tester Data Sheet

Predictions:

Material	A Weight of Soaker Tester (dry)	B Weight of Soaker Tester (wet)	C Weight of Water B minus A
Live Moss			
Peat Moss			
Sod			
Sand			
Rock			

Circle the number by the correct statement and complete the sentence.

1. My prediction was correct because

2. My prediction was incorrect because

LOCATING LOCAL WETLANDS

Objectives

Students will:
1. Locate local wetlands.

2. Explore the relationship of wetlands to other features of the land.

3. Explore the interrelationships of wetlands and human uses of wetlands.

Method

Students will locate wetlands on maps and aerial photographs and make interpretations by filling out a worksheet.

Materials

- topographic maps
- aerial photographs (color infrared, if available) and/or wetland maps of your local area or a nearby area with wetlands. Information on ordering aerial photographs and wetland maps is given at the end of this activity.

Procedure

1. Review with the class the types of Alaskan wetlands described in "Waterlogged Worlds." Discuss with the students what types of wetlands occur in your local area. Have them research the meanings for: **aerial, infrared,** and **topographic.**

2. Divide the class into small groups and give each one a topographic map, an aerial photograph, and wetlands maps. Give each student a description of Alaskan wetland areas and a student worksheet.

3. Have the students try to locate wetlands on their maps.

4. Have students try to compare the maps with the aerial photograph of the same area they have identified as wetlands. Have them try to locate other areas on the photographs that may be wetlands.

5. Discuss the wetland map symbols shown or described.

Subjects: geography, social studies
Skills: map-reading, classification, observation, analysis
Duration: one to two class sessions
Group Size: small groups
Setting: classroom
Vocabulary: aerial, infrared, topographic
Topics: wetlands, maps, human impacts on habitat

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Currently, the U S Geological Survey does not have specific symbols for Alaskan wetlands other than those shown on the worksheet. Discuss how to locate wetlands on aerial photographs. On black and white photographs any standing water will appear dark Water will appear dark blue or black on color infrared photographs It may be brownish around rivers and lakes You can "ground truth" photographs by finding a lake, pond, or stream whose location is known to learn how one wetland area appears Use the keys to the wetland maps and compare areas on topographic maps, aerial photographs, and wetland maps to determine how to "read" them.

6 Have the students complete the worksheets.

7 Review the completed worksheets together, comparing the wetlands shown on the maps These questions may help:

1) What does the location of wetlands tell you about them? (They are usually in low elevations and flat areas, near streams and rivers)

2) Were the most wetland areas found on the map or on the photo? What features of the map or photo could account for this?

3) Are there any areas close to existing wetlands that have been altered by human activities? Could part of the wetland have been filled in? What makes you think so? (Look for wetland areas whose boundaries are straight lines. This may indicate that part of the wetland has been filled in along a survey line, property boundary, drainage ditch, railroad grade, or road bed.)

4) Follow water courses in the photos. Can you find examples where water has been diverted from the wetland by a ditch or other structure? Can you see areas where discharges of treated waste water or other types of discharges are occurring? Are there changes in the color of water in streams for example where a glacial stream enters a clearwater stream?

5) Locate settlements, fish camps, or special use areas Which areas in the future will be settled? Give your reasons based on present situations

6) What natural resources (minerals, timber, oil and gas) are found in your areas? Will use of these resources affect local wetlands?

7) Have areas with low elevations been filled or used for buildings and roads? Do you think these may have been wetland areas at some time? How could you find out?

8) Some Interior Alaskan villages have been moved because of changes in the flow of rivers Tanana, Nenana, and Ruby Find these villages if they are on your map. Valdez was moved in the 1970s following an earthquake and tidal wave What part do you think low-elevation and wetland areas played in the selection of a new site for these towns and villages?

9) Does the map show permafrost areas? A large portion of Alaska is underlain with permafrost. What is the effect of frozen ground on water flow and runoff from rain and melted snow?

10) Brainstorm about the animals and plants that would be found in your local wetland

Reference

Demeo, Tom. Limited quantities of laminated cards of plants for Southeast and Prince William Sound Ketchikan. U.S. Forest Service

Extensions

1 Some plants are key indicators for wetlands because they only grow in areas with wet soils or standing water. Brainstorm about which plants in your area might fit this category. Research those plants to find out whether they always grow in wet areas and what type of soils they need (See Resources section for references)

2 Find out who owns several wetlands in your area Contact your local government to find out if there is a community plan for use or protection of wetlands.

3. Follow-up with a field trip to a wetland you have located.

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How to Order Aerial Photographs

Write or call the National Cartographic Information Center, Geological Survey, USDI, 4230 University Drive, Anchorage, AK 99508-4664 (271-4159), or the Remote Sensing Data Center, Geophysical Institute, UAF, Fairbanks, AK 99775-0800 (474-7558).

Send for information on ordering aerial photographs. You will need to know the geographic coordinates of the area, or send in a USGS topographic map with the area indicated. Standard print sizes are 9" X 9" with a variety of enlargements available. Preferences for black and white, color, or color-infrared (best for distinguishing vegetation and water differences), for viewing specific features, for time of year, and for high or low altitude photography can be specified. They will advise the best selection available and the prices, which range from $3.00 to $100.00. Standard 9" X 9" color infrared photos cost $8.00 from NCIC and cover 64 square miles. If you live in Fairbanks or Anchorage you can go to the photo libraries in each agency and preview photos for ordering.

How to Order Wetland Maps

Contact the National Wetlands Inventory Program - U.S. Fish and Wildlife Service, 1011 East Tudor Road, Anchorage, Alaska 99503 (786-3403), for copies of detailed wetland maps at the same scale as USGS topographic maps (available for most urban and many other areas of Alaska). They can also provide wetland plant lists and information on wetland functions and values.

Locating Local Wetlands Worksheet

Which of these Alaska wetland areas are found in your area?
_____Saltwater wetlands

_____Stream or river corridors

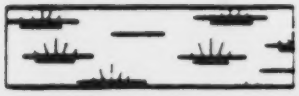
_____Marshes (includes edges of ponds and lakes with plants)

_____Tundra

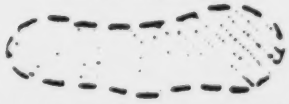
_____Bogs and Muskegs

Streams, lakes, and ponds are shown in blue on topographic maps. Here are samples of symbols used on topographic maps to identify wetland areas

Marsh



Intermittent Lake



Aerial photography provides a bird's-eye view of the land and water. Lakes, streams, and marshy areas with standing water are easily identifiable as are buildings, roads, and other structures. Infra-red aerial photography uses a special kind of film. Areas with water generally appear black or a dark shade of blue on the infra-red photos and darker than other areas on both color and black-and-white aerial photos because less light is being reflected back to the camera where there is water on the ground. However, substances in the water, such as glacial or human-caused silt discharge can increase reflection and the water will appear lighter and may even be whitish.

Using the map and the photograph and your knowledge of the area, answer the following questions.

1. Find the wetland areas (remember streams, lakes, and intertidal areas include wetlands as well as marshy areas.)

What clues did you use to find them?

2. List the **different kinds** of wetlands that you can find.

Place a check mark by each of the wetlands that you listed above as being in your area which can be located on your map or photo.

3. Are all the wetlands found in only one area? List the area.

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4 Are all the wetlands found close to a major source of water?

What clues do you use to determine if a stream or lake is fed by glaciers?

5 If you have a wetlands map, use the key to map to see how the areas you identified as wetlands were classified.

6. During what season was the photo taken?

What clues did you use to decide the season?

7 What is the range of elevation of the wetland areas on your map?

8 Find other areas of similar elevation on the map. If the areas of similar elevation are not wetlands, have they been developed?

Could they have been wetlands at one time?

If so, what other clues besides elevation led you to that decision?

9. How have wetland areas been used in your own community?

10. Have any wetlands near your community been set aside or protected?

Unit 2 — Wetland Functions

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Students use a three-level guide to read an article and explain why some bog-dwelling plants are carnivorous.

WETLAND METAPHORS

Objectives

Students will:
1. Describe the characteristics of wetlands.

2. Demonstrate their understanding of the importance of wetlands to wildlife and humans.

Method

Students are presented with a selection of "hands on" objects for investigation as metaphors for natural functions of wetlands.

Background

The wetlands found in coastal and freshwater settings provide unique habitats that serve areas far beyond their boundaries. Freshwater wetlands often act as buffers in times of flood and drought. Absorbing overflow from flooding, wetlands often swell with runoff water and reduce potential downstream effects of flooding. In drier periods, wetlands hold precious moisture after smaller bodies of water have disappeared. Both freshwater and coastal wetlands are nurseries for countless life forms. They contain a great diversity of plants and animals and provide habitat for migratory wildfowl. Wetlands have a unique ability to trap and neutralize sewage waste, allowing silt to settle and promoting the decomposition of many toxic substances. Yet, it must be remembered that, as remarkable as they are, the actions and capacities of wetlands still have limits. Too much pollution can destroy a wetland.

Many of the functions of Alaska wetlands can be explored through metaphor. A metaphor is a direct comparison between two things; it gives a vivid image through direct comparison. "A tree is a home," "books are windows of thought," and "she is a tower of strength" are three examples. In this activity, a variety of objects represent the characteristics of wetlands. For example:

Subjects: science, language arts
Skills: analysis, application, classification, comparing similarities and differences, description, generalization, identification, inference, interpretation, listing, public speaking, recognition, reporting, small group work, synthesis, visualization
Duration: one to two 30-60 minute sessions
Group Size: any
Setting: indoors or outdoors
Vocabulary: wetland, function
Topics: artistic expression, communication, cycles, habitat for wildlife, habitat loss

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OBJECT	METAPHORIC FUNCTION
sponge	absorbs excess water caused by runoff; retains moisture for a time even if standing water dries up (e.g., sponge placed in a small puddle of water absorbs water until saturated, then stays wet after standing water has evaporated)
pillow or bed	is a resting place for migratory birds
mixer or egg beater	mixes nutrients and oxygen into the water
cradle	provides a nursery that shelters, protects, and feeds young wildlife
sieve or strainer	strains silt, debris, etc., from water
filter	filters smaller impurities from water
antacid	neutralizes toxic substances
cereal	provides nutrient-rich foods
soap	helps cleanse the environment, as wetlands do

Materials

- A large pillowcase
- bag, or box
- sponge
- small pillow
- soap
- eggbeater or mixer
- small doll cradle
- sieve or strainer
- paper (coffee) filter
- antacid tablets
- small box of cereal
- 3x5 inches cards with pictures that could be used to show other wetland metaphors (a zoo could represent the idea of wildlife diversity in a wetland; a lush vegetable garden could represent the idea of a productive wetland in which food is abundant, a vacation resort could represent the idea of a resting or wintering place for migrating waterfowl)

Note: A metaphoric approach such as this allows a variety of objects to suggest some appropriate linkage to the basic characteristics of wetlands

Procedure

1. Prepare a "Mystery Metaphor Container" (pillowcase, bag or box). It should be possible for a student to put his or her hand into the container and pull out an object. You may want to collect as many as one metaphoric object per student, but at least have enough for one per group of four students. Put the container aside to use later.

2. Discuss the variety of wetlands found in your local area, state, country, etc. Then invite the students to sit quietly and close their eyes. Ask them to imagine and visualize a wetland. Have them look carefully at the plants and animals, including insects and small creatures. What does the air feel like? How does it smell?

OPTIONAL. Play a tape recording of natural sounds from wetlands. Some are available commercially in record and nature stores.

3. Invite the students to tell what they imagined. Compile a list of their offerings. Encourage discussion and mutual sharing.

4. With their list as a point of reference, help the students identify which plants and animals are actually most likely to be found in a wetland. If possible, have them classify the plants and animals according to the kind of wetland in which they would be found.

5. Provide the students with background information to serve as an overview of the basic ecological activities that characterize the wetland habitat. For example, you can include the following:

- Sponge effect - absorbs runoff
- Filter effect - takes out silt, toxins, wastes, etc.
- Nutrient control - absorbs nutrients from fertilizers and other sources that may cause contamination downstream
- Natural nursery - provides protection and nourishment for newborn wildlife
- etc.

Suggest that these ecological activities are taking place in wetlands all the time.

6. Bring out the "Mystery Metaphor Container." Tell the students that everything in the container has something to do with a wetland. Have the students divide into groups of four. Announce that when it is their turn, you want a representative of each group to draw an object from the container. Then, as a group, they must figure out how the object could represent what a wetland is or does.

7. Have the designated student reach into the container and withdraw one object. When each group has an object, ask them to work as a team to describe the relationship between their metaphoric object and the wetland. Encourage the students to build on each other's ideas. You can also assist by strengthening their connections. NOTE: Allow the students time to discuss their ideas with each other before doing so in front of the entire class.

8. Ask each group to report their ideas to the class.

9. Following discussion and review of the functions represented by each metaphor, ask the students to summarize the major roles that wetlands perform in contributing to habitat for wildlife. List the ways in which wetlands are important to humans.

10. For the final part of this activity, encourage the students' understanding of how the wetlands' conditions depends on each of us. Many kinds of wildlife depend upon wetlands. Our own well-being requires wetland ecosystems. Strengthen the students' understanding of the connections that humans have to wetlands.

Recreation, aesthetics, utilitarian uses, environmental quality, and nature study are but a few of the connections we have with wetlands.

Evaluation

Why are wetlands called one of the world's most productive ecosystems?

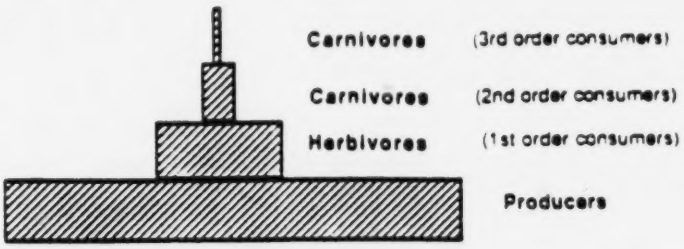
Reference

Adapted from Aquatic Project WILD

Extension

If you take a wetlands field trip, verify the appropriateness of the metaphors explored in the classroom. Identify and discuss any limitations to the appropriateness of these metaphors. Identify what seems to be the most compelling attributes of the metaphors. Identify new and appropriate metaphors!

ENERGY FLOW IN AN ALASKA WETLAND



Objective

Students will:
Construct wetland food webs and trace energy flow through the system.

Method

Students will play a game illustrating energy flow.

Background

In the game "Energy Flow in a Wetland," your students will see how energy is passed through a wetland. All the energy in a wetland comes from the sun. Plants get energy, measured in calories, from the sun. They use this energy to make food by photosynthesis. In wetlands, algae, which are microscopic and live in water, is one of the major groups of plants that make food available to other organisms. As aquatic insects eat algae, they take in some of the sun's energy stored in the form of food. Ducks and fish eat the insects; bigger fish eat smaller fish; and humans eat the biggest fish. All living things die eventually and are eaten by bacteria and fungi which produce (or recycle) minerals that plants can use to make food. Thus, food and energy are passed along a chain or along several interlocking food chains to form a web. It all depends on "who eats whom!" As your students play the game, they'll discover that less energy is available for organisms as it passes to higher levels of the chain.

Is Energy Wasted?

Only some of the energy available to living things ends up in food chains in its "stored" form of food. What happens to the rest of the energy? A plant uses only 3% of the sun's energy available to it. In other words, out of 10 million calories of sunlight, about 300,000 are captured by plants and stored in such organic compounds as sugar, starch, and cellulose. However, an aquatic insect, such as a dragonfly nymph eating algae, gets about 10 percent of the energy captured by the algae, or 0.3 percent of the energy that came from the sun in the first place, and so on up the chain: the stickleback can store only .03 percent, the salmon only .003 percent, and humans only .0003 percent.

Why can wetland plants store only 3% of the energy? Plants can only capture the sun's energy during the daytime, but they use energy to live all of the time. Plants are constantly growing and using energy to reproduce.

Why are organisms at each stage of the wetland food chain able to store only 10% of the energy available? Animals are generally not efficient at eating all the food available to them. If they were, plants would soon be

Subjects: science, math
Skills: analysis, classification, computation, inference
Duration: two class sessions
Group Size: small groups (two-six can play the game)
Setting: indoors
Vocabulary: food chain, food web, producers, consumers, herbivores, carnivores, decomposers, detrivores, photosynthesis, energy
Topics: cycles, ecosystems, energy, food chain

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scarce, and animals scarcer! Animals must use energy when they move, sense and respond to the environment, grow, and reproduce. Also, not all of the food consumed can be digested and stored; some is excreted as waste products.

Is the energy wasted? The energy that is not captured by plants remains in the form of light and heat, but it is mostly lost to the living system. When stored energy is used by living things, it is changed into another form — heat, motion, etc. — and thus cannot be reused by other living things. However, some of the energy lost as waste products in each link of the chain can be used by detrivores. Many plants and animals die without being eaten, but this stored energy is also recycled by the decomposers. Wetland food webs often have much more energy flowing through the detrital food chains and webs than through the webs composed of producers and consumers. Still, the energy stored in the living system constantly decreases and much cannot be recaptured.

These energy facts at each link of the food chain limit the number of living things that can exist. Thus, carnivores are less numerous than herbivores, and food chains rarely have more than four links. Consumers in the 5th and 6th links on longer chains must always feed on several different kinds of living things in order to get enough energy to survive.

Materials

- Energy Flow in an Alaska Wetland boardgame
- Energy Flow in an Alaska Wetland game rules and Energy Use Charts
- one die
- markers
- scratch paper or calculator

Procedure

1. Post the Energy Flow in an Alaska Wetland boardgame on a bulletin board or chalkboard. Discuss the concepts of producers, consumers, herbivores, carnivores, omnivores, detrivores, and decomposers with the class. Have the students identify which of the plants and animals on the poster fit into each category.

2. Divide the class into three groups and distribute the Wetland Cards, as follows:
Freshwater Wetland: bacteria, green algae, burreeds, amoeba, mosquito, dragonfly, wood frog, sandhill crane, grayling, arctic fox, human

Bog: bacteria, sedge, black spruce, sphagnum moss, muskrat, mosquito, sundew, little brown bat, human

Forested Wetland: mushrooms, horsetails, lichens, willows, springtails, shrews, moose, weasel, wolf, brown bear, human

Salt Marsh: bacteria, eelgrass, arrowgrasses, black brant, Canada goose, bald eagle, pink salmon, brown bear, human

3. Have students in each group take turns reading aloud the portions of their card "Food" and "Eaten by." The group will then work together to diagram the food chain connections among the organisms. Post these diagrams next to the poster.

4. Play the "Energy Flow in an Alaska Wetland" game. For large classes, small groups can each represent one player and be responsible for making the calculations for each move.

Evaluation

After playing the game, discuss the following:
1. In your own words, tell what a food web is.
2. What happens to most of the sun's energy that reaches a wetland?
3. Tell why or why not you agree or disagree with the statement: "A wetland is not a productive area because so much energy is wasted in the food web."
4. How can you explain the fact that organisms at the end of the food chain get the least amount of energy? Doesn't that mean that they are all going to starve to death?

Extensions

1. Have students write a short story from the viewpoint of a unit of energy moving through a wetland food web.

2. Have students research ecology books to determine if other types of ecosystems (for example, forests, grasslands, savannahs, oceans) do a "better job" than wetlands of capturing and storing the sun's energy. (Consider this: can producers capture more than 3 percent and consumers store more than 10%?) They can also research comparisons between colder areas nearer the poles and warmer areas nearer the equator.

3. Discuss the "pyramid of numbers" in a wetland area. This concept can be used to help answer question #4 above.

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Energy Flow in an Alaska Wetland Game Rules

The winner of this game is the one who gets to the top of the food chain (where he or she is eaten by the marsh hawk, bald eagle, or human being) with the greatest number of calories left.

A player can quickly exhaust the calories allotted as he or she meets calorie-consuming situations and events in the lives of organisms on the food chain. Merely staying alive uses up energy (in the form of respiration).

The game has been designed to illustrate the complexity of a wetland ecosystem, the interdependence of living things, and the importance of the sun's energy in making the ecosystem work. The calorie counts for a given situation are estimates and have been calculated to make events in the game as realistic as possible. However, they should not be considered complete and accurate measures of all energy consumed.

The materials you will need for this game are:

1. The Energy Flow in an Alaska Wetland Poster Game
2. The Energy Use Charts
3. A die
4. Markers
5. Scratch paper or calculator

Here are the rules for the game:

1. Two to six can play at once.
2. Each player places a marker on the sun and starts the game with solar energy equal to 10,000,000 calories.
3. Players move in turn on the throw of a die. Each player follows a sunbeam to a plant (orange start circle).
4. When moving from the sun to a plant, players lose 97 percent of their energy, so they must subtract 9,700,000 calories from the 10,000,000 with which they started the game. Players are thus left with 300,000 calories, or 3 percent of their initial energy.
5. Players advance through the food web with each roll of the die, moving as many spaces as the die indicates.
6. Players landing on green spaces must pay the respiration tax indicated on the circle. For example, if a player with 150,000 calories lands on a green space marked 15,000, the player must give up 15,000 calories. The player would then have 135,000 calories remaining.
7. When a player lands on a tan space, he or she must check the Energy Use Chart to find out what energy-consuming event has occurred and how many calories it has used. For example, CT1 (meaning cattail space #1 on the chart) reads "fungus infection on leaves, use 100,000 calories." This means that the organism has contracted a fungus infection and any player landing on CT1 must subtract 100,000 calories from his or her supply.
8. When a player lands on a white space, no calories are lost.
9. As a player reaches an orange space, which allows him or her to move from one organism to another, the player becomes food for the new organism. Whenever that happens, 90 percent of the player's remaining calories must be surrendered. (A player keeps 10 percent.) Percentages can be figured on the scratch paper or with the calculator.
10. Players enter a new organism on its start orange circle. A player must stop on the circle, give up the 90 percent described in Rule 9, and wait until the next turn before advancing through the organism.
11. A player who uses all of his or her calories before reaching the top of the food chain — the marsh hawk, bald eagle, or human being — has burned out and is no longer in the game.
12. The player reaching the marsh hawk, bald eagle, or the human being with the most calories remaining is the winner. If every player burns out, there is no winner.

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Energy Use Chart

Stickleback

S 1 Courtship ceremony.
Use 800 calories.

S 2 Migrate by stream to lake.
Use 600 calories.

S 3 Develop infection of scales.
Use 500 calories.

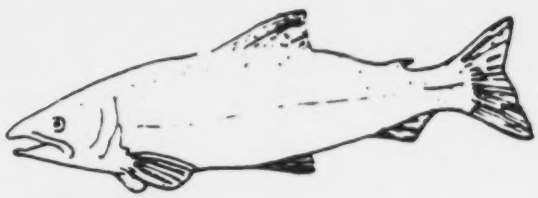
S 4 Produce eggs.
Use 350 calories.

S 5 Population explosion. Heavy competition for food.
Use 500 calories.

S 6 Fin torn. Repair tissue.
Use 600 calories.

S 7 Hot spell increases water temperature. Metabolism increases.
Use 400 calories.

S 8 Narrowly escapes attack by coho salmon by swimming rapidly.
Use 300 calories.



Coho Salmon

CS 1 Gill disease.
Use 85 calories.

CS 2 Chase other males from territory.
Use 60 calories.

CS 3 Migrate upstream.
Use 100 calories.

CS 4 Hooked by fisherman but broke his line.
Use 10 calories.

CS 5 Swim up wrong tributary stream, must return.
Use 50 calories.

CS 6 Chased by brown bear.
Use 40 calories.

CS 7 Stressed by crowding during migration.
Use 40 calories.

Aquatic Insects

AI 1 Grow new exoskeleton.
Use 5,000 calories.

AI 2 Bacterial disease.
Use 3,000 calories.

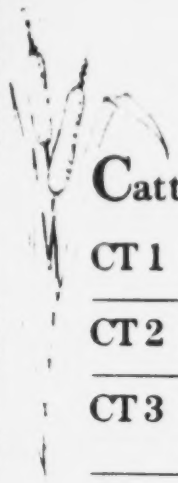
AI 3 Change into adult insect.
Use 2,500 calories.

AI 4 Repair wounds to body.
Use 2,000 calories.

AI 5 Chased by stickleback.
Use 1,500 calories.

AI 6 Time to lay eggs.
Use 3,500 calories.

Energy Use Chart



Cattail

CT 1 Fungus infection on leaves
Use 100,000 calories

CT 2 Replace tissues eaten by moose
Use 60,000 calories.

CT 3 Seawater floods marsh destroying much tissue
Use 60,000 calories.

CT 4 Produce new plants by underground buds.
Use 50,000 calories.

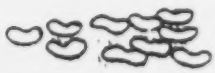
CT 5 Humans gather underground stems for food throwing away leaves and flowers
Use 40,000 calories.

CT 6 Chemicals seep into marsh causing abnormal growth
Use 25,000 calories.

CT 7 Spring fire damages new growth
Use 10,000 calories.

CT 8 Burrowing mammal destroy roots.
Use 50,000 calories.

Duckweed



D 1 Fertilizers seep into marsh causing abnormal growth.
Use 50,000 calories.

D 2 Shaded by shrub.
Use 30,000 calories.

D 3 Attacked by fungus.
Use 25,000 calories.

D 4 Repair damaged tissue shredded by propeller.
Use 20,000 calories.

Grasses and Sedges

GS 1 Drought dries out ground around roots
Use 25,000 calories.

GS 2 Produce seeds
Use 40,000 calories.

GS 3 Partially covered by road construction
Use 35,000 calories.

GS 4 Shaded by taller growing cattails
Use 20,000 calories.

GS 5 Storm floods marsh and covers leaves with water.
Use 25,000 calories.

GS 6 Fungus disease
Use 30,000 calories.

GS 7 Underground stems trampled by animal trail
Use 30,000 calories.

GS 8 Leaves used to build duck's nest
Use 25,000 calories.

Algae

A 1 It's time to reproduce.
Use 40,000 calories.

A 2 Repair tissue damage caused by storm.
Use 30,000 calories.

A 3 Mold grows into tissues and takes food.
Use 20,000 calories.

A 4 Sewage spill stimulates abnormal growth.
Use 10,000 growth.

A 5 Viral infection.
Use 40,000 calories.

A 6 Water becomes deep. Grow longer branches.
Use 60,000 calories.

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Energy Use Chart

Muskrat

M 1	Produce and nurse two offspring. Use 7,000 calories.
M 2	Shed winter coat. Use 7,000 calories.
M 3	Grow winter coat. Use 6,000 calories.
M 4	Build house on bank of stream. Use 5,000 calories.
M 5	Attacked by marsh hawk. Dive and swim to safety. Use 5,000 calories.
M 6	Population explosion. Battle for territory. Use 3,000 calories.
M 7	Late summer fire destroys habitat. Move to new location. Use 3,000 calories.

Pintail

P 1	Habitat destroyed. Migrate 100 miles. Use 3,000 calories.
P 2	Viral infection with high fever. Use 2,500 calories.
P 3	Replace lost feathers. Use 2,000 calories.
P 4	Overpopulation. Heavy competition for food. Use 7,000 calories.
P 5	Build nest. Use 6,000 calories.
P 6	Courtship ceremony. Use 5,500 calories.
P 7	Search for new food supply. Use 5,000 calories.
P 8	Predator attack. Defend nest. Use 5,500 calories.

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ECOLOGICAL PUZZLERS

Objective

Students will recognize that human activities can have far-reaching effects on wildlife.

Method

Students will use information in the Ecology Puzzlers to make conclusions about how, through ecological connections, certain human activities can have long-lasting effects on ecosystems.

Materials

- Copies of Ecological Puzzler sheets (one per student, puzzle only)

Procedure:

1. Photocopy the puzzlers so each student can have a copy of one puzzler. Students may work in groups (all with the same puzzle) or individually.

2. After handing out the puzzlers, explain that students are to use the facts provided on the study sheet to figure out the answer to the puzzle. To solve each puzzle, students will need to read each puzzle carefully, look for connections in the information, and apply their knowledge of ecology.

3. Review each puzzler with the class. Have those who worked on each puzzler explain the puzzler and the solution or prediction at which they have arrived based on the facts provided. Have the class discuss the puzzler, then read the solution or prediction of the scientists.

4. Have students describe why scientists are often unable or unwilling to precisely predict the effects of human activities on ecosystems.

Subjects: science, social studies
Skills: data analysis, inference, problem-solving
Duration: one class session
Group Size: individuals or small groups
Setting: classroom
Vocabulary: ecology, limiting factors, carnivorous

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INSECTS BEWARE!

Objective

Students will determine the function of carnivory for bog plants.

Method

Students will use a three-level guide to read an article and explain why some bog-dwelling plants are carnivorous.

Materials

- Copies for speakers - Liar's Club Class Information and Speaker sheets
- Partner copies (enough for half the class) of: Alaska Fish & Game March/April article Insects Beware! and Carnivorous Plants Guide
- Class copies of: Carnivorous Plants Matching Square

Procedure

1. Before the lesson begins, enlist four students' help (you may want to select better readers or those who enjoy role playing). Explain to the helpers that they are to pretend to be members of the Liar's Club of America and will present different views on why certain bog plants have adapted to being carnivorous. They are each to pretend that they are right and the other two are lying. The class will be voting on what they have to say and a convincing job of acting may sway more votes their way. Each will read the Liar's Club Class Information View 1, View 2, and View 3. The class may then vote on which view seems the most plausible. Encourage students to base their votes on the actual content, not on the persuasiveness of the speaker.

2. Have the three students present their views and hold the vote.

3. Tell students that an article they will soon read discusses a specific wetland type - a bog (also called a muskeg). Have students review characteristics of a bog or write them on the board (waterlogged or frozen soil, little oxygen, slow decomposition, many layers of peat moss, acidic environment).

4. Have students work in pairs. Give each pair a copy of the article

Subjects: science, language arts
Skills: interpreting data, analysis, application, discussion
Duration: two to three class sessions
Group Size: whole class in pairs
Setting: classroom
Vocabulary: carnivorous, bog
Topics: adaptations

and guide. They are to first preview the Carnivorous Plants Guide, read the article, and then complete the guide. Go over the guide with them and explain that the first section has statements in the article that are true or false. In the second section, students must choose which statements the author meant to convey but did not directly say (what the student can **infer**). Finally, the third section has statements that students may mark as true if they can be applied to what they already know and have read.

5. After completion, each pair may get together with another pair to discuss their answers. Go over the guide with the whole class to discuss answers.

6. Have students vote again on which "liar" was correct. Reread View 1 or have students sum up why carnivorous plants have adapted to bogs by becoming carnivorous (bogs have acidic waters and it is difficult for plants to obtain all the minerals they need; they can get additional minerals by capturing and digesting insects).

LIAR'S CLUB CLASS INFORMATION
CLUB PRESIDENT

As the president of the Liar's Club of America, I would like to welcome you all here today and introduce you to my fellow members. Well, a couple of my fellow members. I guess we never really know if people are members or not because, of course, we might be lying. Anyhow, the three folks I have for you today will present three different views on why carnivorous plants have adapted to bogs by catching insects. Only one person is not a charter member of the club and that person will be giving the true scientific view. The other two will be doing what our club members do best - and you know what that is!

You will have the opportunity to vote on which one of us has the true answer before and after you read an article called "Insects Beware!" If you preview the Carnivorous Plants Guide and read "Insects Beware!" thoroughly (which will be handed out later), you should have a pretty good idea of why certain bog plants have adapted to their habitat by being carnivorous . . . and I'm not lying!

And now, our first liar . . . uh, I mean speaker.

VIEW 1

I will begin by telling you that you need not even listen to the other speakers as they will absolutely be lying. Listen closely now to the real truth of the matter. An excellent plant adaption to life in a bog is to become carnivorous. Peat moss accumulates and decomposes very slowly. It releases tannins and acids that make the bog highly acidic so only specialized plants can live there. It is difficult for bog plants to get important minerals (such as nitrogen and phosphorus) from their acidic surroundings. Some plants make up for this loss by allowing special fungi to grow on their roots that help them absorb these minerals. Others have leaves that are tough and waxy that allow them to collect more rainwater. These plants can get some minerals from this rainwater. Therefore, I can heartily conclude that carnivorous plants catch and digest insects to get minerals that they need.

VIEW 2

Well, it's pretty obvious who the liar is thus far. Now let me share with you the ultimate truth about adaptations of carnivorous plants. Because of low light conditions in the peat-infested bog waters, some plants are unable to photosynthesize. Their photosensors are not strong enough to deal with the darkened bog environment; thus, they have adapted by developing traps that capture insects. Plants digest the insects to obtain oxygen, carbon, and hydrogen - necessary to synthesize plant food products. Therefore, it can be said in all honesty that the inability of carnivorous plants to photosynthesize has led to the adaptation of capturing insects for food.

VIEW 3

You can now totally disregard the barefaced lies of my associates and listen to the complete, scientific explanation of why certain plants are carnivorous. It is obvious that their ideas, besides being completely preposterous, are much too narrow in focus. In Alaska, carnivorous plants are bog dwellers - a substrata also conducive for insect larvae. In looking at the ecosystem as a whole, one can recognize that an insect population must have controls; otherwise, population increases of plague proportions would occur. The question is not why carnivorous plants have adapted to bogs by eating insects, but rather, why are they useful to their ecosystem as a whole? The answer: They are essential for insect population control.

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Carnivorous Plants Guide

Name _____

Directions: Check the statements that were in the article.

_____1. Sundews are suspended by small floats in the water

_____2. Insects are always killed upon contact a carnivorous plant.

_____3. Decomposition is the breaking down of dead plants and animals.

_____4. Bogs have plenty of water, carbon dioxide, and minerals, but lack light.

_____5. The bladderwort has the fastest known trap for plants.

Directions: Check the statements that you can infer from reading the article (what can be read "between the lines").

_____1. All plants should develop ways to catch insects.

_____2. The lack of oxygen in bogs slows down decomposition and thus the availability of minerals.

_____3. All bog-dwelling plants are carnivorous.

_____4. Bogs are acidic environments where plants must have special adaptations to survive.

_____5. Carnivorous plants have developed the ability to catch and digest insects to make up for the lack of minerals in their bog habitat.

Directions: Check the true statements that would apply to what you know about carnivorous plants.

_____1. The environment determines what life forms can occupy it.

_____2. An organism's survival depends on its adaptations to its environment.

_____3. Plants and animals are interdependent (dependent on each other).

_____4. All plants depend on the sun for survival.

_____5. Plants can adapt to any environment.

Carnivorous Plants Matching Square

Directions: Select the numbered statement on the right that best matches the word on the left (according to the "Insects Beware" article). Put the number in the proper space in the matching box. The total of the numbers will be the same across each row and down each column.

WORDS	STATEMENTS
A. decomposition	1. a bog is one type
B. pollination	2. fertilization of plants
C. carnivores	3. catch their own food
D. butterwort	4. necessary for decomposition
E. bladderwort	5. are found underwater
F. sundew	6. another word for bog
G. bog	7. a decomposer
H. peat moss	8. type of bog soil
I. minerals	9. not readily available in bogs
J. bacteria	10. peat moss grows here
K. muskeg	11. sea anenome-like murder weapon
L. larvae	12. prey of bladderwort
M. oxygen	13. looks like a violet
N. bladder	14. prison for water dweller
O. acidic	15. type of water in bog
P. wetland	16. breaking down of plants and animals

A	B	C	D
E	F	G	H
I	J	K	L
M	N	O	P

Matching Number is _____

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Unit 3 — Humans and Wetlands

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Traditional Wetland Plant Use 54
Students learn about traditional Alaska Native uses of wetland plants by presenting a group pantomime. They will listen to a story and then create their own story.

What's In A Name? 59
Students read different names and create their own names to describe birds or some aspect of their ecology.

Wetland Worth 63
Students work in groups to examine a collection of "artifacts." They create a role play or short story that explains how their "artifacts" were used in wetland areas by these "primitive" people.

Deadly Waters 65
Students analyze the pollutants found in a hypothetical river. They graph the quantities of pollutants and make recommendations about actions that could be taken to improve wetland habitat.

A Wetlands Visit 77
Students read a fun wetland story. This activity is a good follow-up to a wetlands field trip.

TRADITIONAL WETLAND PLANT USE

Objectives

Students will:

1. Name and describe three wetland plants and the way in which they were important to Alaska's Native peoples.

2. Write a story describing how a wetland plant came to be useful to Alaska Natives.

Method

Students will learn about traditional Alaska Native uses of wetland plants by presenting a group pantomime. They will listen to a story and then create their own story.

Background

Alaska's Native peoples have traditionally demonstrated widespread knowledge of a variety of uses of plants and animals. Plants were used extensively by all of Alaska's Natives in a number of different ways. Although plant species and traditional uses varied among Native groups, there has always been an important connection between plants and people. **Ethnobotany** is the study of how people use plants. By becoming familiar with the ethnobotany of a culture, one can appreciate the cultural identity and traditions of a particular group of people as well as understand the botany of a specific ecosystem. Wetlands provided a diverse number of plants which were widely used by Native Alaskans and which continue to have important uses today. Conservation of these plants has important implications for people not only in terms of present uses but for possible future uses.

Materials

- Group copies of "Traditional Uses of Wetland Plants"

Procedure

Activity 1

1. Ask students to imagine how Native Alaskans might have used plants hundreds or thousands of years ago before stores or modern products were available. List the uses that students come up with.

2. Define ethnobotany - the study of how people use plants; "Ethno" = People + "Botany" = Study of Plants.

Subjects: science, language arts, social studies, bilingual studies
Skills: description, application, group cooperation, identification, listening, designing, research role playing, writing
Duration: two class sessions
Group Size: whole class, small groups
Setting: indoors and outdoors
Vocabulary: ethnobotany, tale
Topics: artistic expression, communication, identification of plants and animals

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3. Divide the students into groups of two or three students (there should be eleven groups at the most - one plant for each group). Hand out copies of "Traditional Uses of Wetland Plants." Assign a wetland plant to each group and have them devise a short pantomime involving all members that shows **how** the plant is used and **what** it is used for. After each group completes their pantomime, students may guess which plant the group presented.

4. Students should try to think of a modern use that best fits the traditional use of each wetland plant to help them remember it. Have students write down their ideas in the Modern Use section of the worksheet.

5. Have students share the modern use they came up with for each plant. Ask if wetland plants are still useful today. Are wetland plants still used traditionally in your local area? How? Since modern products are now available, why continue to use plants in the traditional way? (For passing on the beliefs, values and traditions of a culture?) What reasons might there be for conserving wetland plants (cultural traditions, habitat, sediment control, possible future uses)?

6. Research to find out how animals may use these plants. Add the information as a fourth column on the worksheet (i.e. beaver harvest great quantities especially when aspen, willow and aspen are scarse).

Evaluation

Students will turn to a partner and name three different wetland plants and a traditional use for each. Or, modern products can be held up and students can write the name of the plant and its traditional use.

Extension

Have students bring in modern products that represent their plant (Nyquil box, waxed paper, throat lozenges, etc.). Create a class bulletin board on ethnobotany of Alaska Natives. Compare or contrast that with how local people use wetland plants today. Invite an elder into the class to talk about traditional Native uses of plants in his or her particular culture.

Activity 2

1. Explain to students that they will create a tale or story about a wetland plant. Explain that in many cultures, tales and stories are passed on from generation to generation. These stories often explain how certain things came to be and may pass on knowledge that helps people to survive (for example, what to eat or not eat) or help them appreciate things in their environment upon which they depend.

2. Show students a picture of a skunk cabbage (if available). Have students listen to the following Kathlamet Indian tale about skunk cabbage (the Kathlamets are a tribe from southwest Washington state).* Point out to students that this myth reveals how the plant was used, why it looks like it does and why it is in a wetlands habitat:

In the ancient days there were no salmon. The Native Americans had nothing to eat except for roots and leaves. One of their most important foods was the root of the skunk cabbage. Finally, after many years, the spring salmon came for the first time. As they passed up the river someone stood upon the shore and shouted:

"Here come our relatives whose bodies are full of eggs. If it had not been for me all the people would have starved."

"Who speaks to us?" asked the salmon.

"Your uncle, skunk cabbage," was the reply.

Then the salmon went ashore to see him, and as a reward for having fed the people the skunk cabbage was given an elk-skin blanket and a war club, and was set in the rich soft soil near the river. There he stands to this day wrapped in his elk-skin blanket and holding aloft his war club.

* This Kathlamet tale was used because the writers were not able to find an Alaskan Native tale about a wetland plant. If you have such a tale which the Native group would be willing to share, please send it in to us for distribution and inclusion in future revisions.

3. Discuss ideas for writing an Alaska version of a story about a wetland plant. Students will develop a story that explains how a particular wetland plant came to be used by Native peoples using the

information on the worksheet, "Traditional Uses of Wetland Plants" or information gained from an elder. Students can also interview local people who are knowledgeable about traditional plant uses. Encourage students to use their imagination by telling them that the plants and animals in their story may walk or talk or do anything else people do.

4. Have students read their stories to the class.

Evaluation

Student stories include information about how the plant was traditionally used.

Resources

Schofield, Janice. 1989. Discovering Wild Plants: Western Canada, The Northwest. Alaska Northwest Books.

Turner, Nancy J., Food Plants of British Columbia Indians. Part 1/ Coastal Peoples, Part 2/ Interior Peoples. Victoria, B.C. British Columbia Provincial Museum Handbook Series.

Heller, Christine. 1985. Wild, Edible and Poisonous Plants of Alaska. Fairbanks, Ak. University of Alaska Cooperative Extension Service Publication No. 28

Jones, Anore. 1983. Nauriat Niginaqtuat, plants that we eat. Maniilaq Association (Inupiat)

Blumenstein, Rita Pitka. 1984. Earth Dyes-Nuunam Qaralirkai: dyes for grass made from natural materials. Institute of Alaska Native Arts (Yup'ik)

Viereck, Eleanor. 1987. Alaska's Wilderness Medicines. Alaska Northwest Books

Extension

Students can illustrate their stories or obtain a sample of their wetland plant and display them with their stories.

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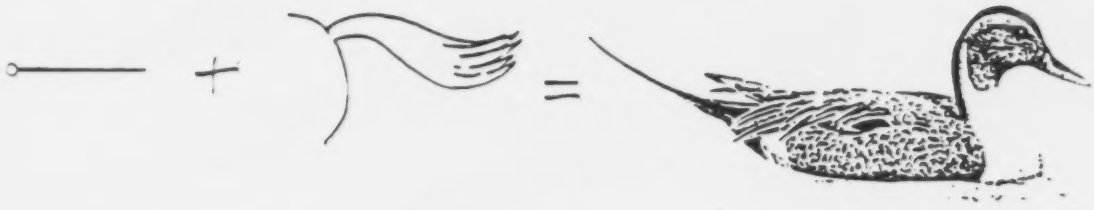
SKUNK CABBAGE

Traditional Uses of Wetland Plants

Wetland Plant	Native Group & Use	Modern Use
Silverweed	**Coastal Indians** - dug up roots and steamed like potatoes	
Labrador Tea	**Coastal Indians** - leaves dried & made into a tea, used as medicine for cold, cough and sore throat	
Yellow Pond Lily	**Athabaskan** - large root is collected, warmed and placed on the skin for relief of pain	
Skunk Cabbage	**Coastal Indians** - waxy leaves used for storing food and wrapping fish for steaming	
Buckbean	**Aleuts** - roots used as a tonic for relief of gas pains, constipation	
Marsh Violet	**Athabaskan** - pleasant smelling roots were dried & used as an incense at potlatches	
Sea Lovage	**Inupiaq Eskimo** - beach plant tastes like celery, provides fiber	
Club Moss	**Athabaskan** - headache remedy, placed on head until headache is gone	
Nettle	**Coastal Indians** - fiber used to make ropes and nets	
Lowbush Cranberries	**Inupiaq Eskimo** - berries spread as a paste on a cloth & wrapped around the neck for a sore throat	
Sphagnum Moss	**Athabaskan** - used for absorbing moisture in baby diapers	

WHAT'S IN A NAME?



Objective

Students will:

1. Compare the information conveyed by various bird names in different languages.

2. Appreciate cultural diversity in relation to the environment.

Method

Students will read different names and create their own to describe birds or some aspect of their ecology.

Background

People use names of animals in order to distinguish among all possible animals and communicate to others. To avoid endless confusion, scientists have developed a worldwide system for naming each animal by a genus and species name in Latin, and these names have been standardized by matching specimens in museums to correct names. **Ornithologists**, the scientists who study birds, have also developed a system to determine the correct "common name" in English for each bird species in America. But other common names still persist and people have traditionally named the animals around them in their native language. The common names, Latin names, and Alaska's Native languages all contain a wealth of information about animals based on the observations people have made. Each name is an attempt to characterize the animal in a way that other people will recognize. The name may convey information about the animal's appearance, its behavior, the sounds it makes, or ecological information about its relationships to other animals or to its environment.

This activity is designed to introduce your students to the different ways that animals are named and the relationship between language and science. Both are based on observation and experience and both communicate predictions about the constancy of future phenomenon.

Subjects: bilingual studies, language arts, science, social studies
Skills: classification,comparing similarities and differences, description, identification, observation
Duration: one to two class sessions
Group Size: whole class, small groups
Setting: classroom
Vocabulary: ornithologist, common name
Topics: classification of species, habitat for wildlife, identification of plants and animals, interdependence, people and wildlife sharing environment, survival needs of wildlife, wildlife ecology

You can make this activity more relevant by having your students find out the names (and translations into English) for these animals in the Alaska Native language of your area or other languages by interviews with people in your community.

This activity can be used in a bilingual or multicultural setting to reinforce the richness of detail and information provided by a diversity of viewpoints and cultures while recognizing the practical advantages of a single standard name for each animal.

Materials

- Copies of the "Bird Names" Table
- bird field guides or books with color pictures of Alaska birds

Procedure

1. Show your students a picture of bird with a descriptive common name (for example, golden plover, red-necked grebe, dipper). Ask them to describe the bird without naming it and write the descriptions on the board. Then, ask them or tell them the name of the bird. Point out that the name included only part of the description but focussed on a prominent characteristic such as color.

2. Explain to your students that an animal can have more than one name if people notice different things about the animal. Also, animals will have different names if they are found in or migrate through different countries and are named by people who speak different languages. Ask them why it might be a good idea for people who use different names for the same animal to have one name that they all use (people would know they were talking about the same animal anywhere in the world).

3. Explain that a group of scientists who study birds (**ornithologists**) in North America, the American Ornithologist Union, have an official list for the "common names" of birds for all English-speaking people. Also, Latin is used to give each animals a two-part name that distinguishes it from all other animals in the world. The first name is the genus name which is shared with similar species, sc , like their "last name," while the second name, or the species name, is like their "first name." Explain that some scientists spend a lot of time comparing specimens of animals in museums to determine whether or not they should have the same or different names. (These common and Latin names are the ones that appear in field guides and natural history accounts.)

4. Brainstorm what type of information about an animal could be conveyed by its name. Tell them they will find out by looking at the different names for some animals found in Alaska as named by Alaska Natives, the American Ornithologist Union, and the Latin name.

5. Pass out the sheet "Bird Names" which compares the names of various wetland birds in English with the translations of their Latin names and their names in Alaskan Native languages. Ask them to make a list of types of information conveyed by the names in each language (English, Latin, Alaskan Native language).

6. Discuss the different types of information conveyed by the different types of names. Discuss why people would make different types of observations of the same animal (e.g., Native people were dependent on some animals for food and did not have a written language, so it was more important to describe them more fully to others when talking; common and Latin names given by scientists sometimes recognize individuals who contributed to science).

7. Divide the class into small groups of 4-6. Have the groups create names for the animals on the color poster or the Wetland Cards. Assign groups one of the following tasks: 1) creating names that are descriptive, 2) creating names that include ecological information, 3) creating names that tell something about the relationship of the animals to humans. Tell them the names or phrases must be distinct enough so the animals cannot be confused with any other.

8. After the groups have finished, have them write the names or phrases they have created on the board. Provide a list of the English common names to the students and have them write down the three names that match each picture and common name.

Evaluation

Did the names created by students illustrate the different types of information about the birds?

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References

Make Prayers to the Raven. Nelson, R.K. 1983. University of Chicago Press.

Randles, P. 1990. University of Alaska Fairbanks. Compiled Native names for several linguists.

Marks, P. 1990. Sealaska Heritage Foundation. Provided Tlingit names.

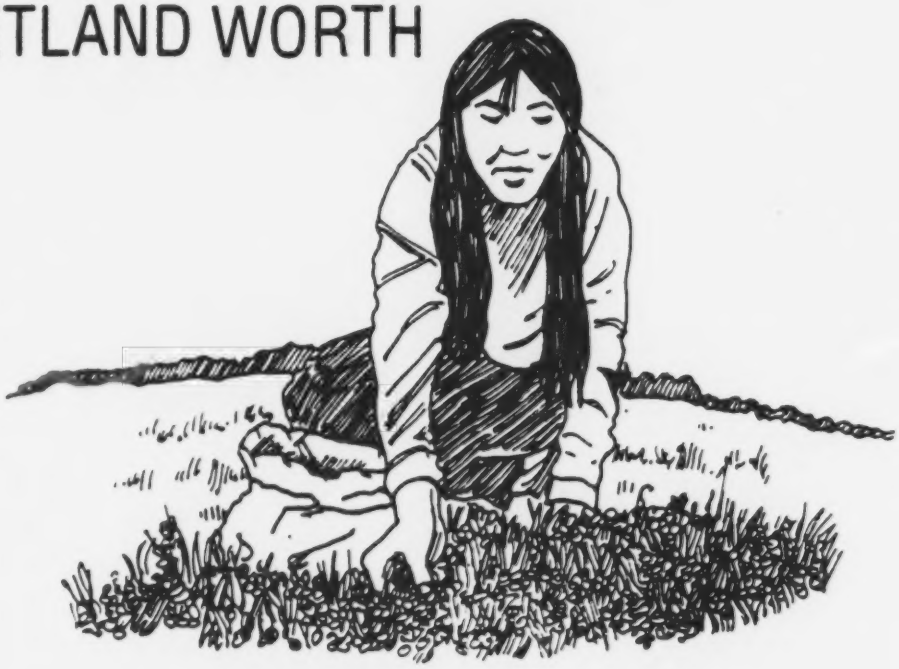
Extension

Research the local names for birds in your area. Find out the names in the Alaskan Native language of your area and their translations. If you have students who speak a foreign language in their home, ask them to bring back a list of the name of the animals in that language and the translations.

Bird Name Table

COMMON NAME	LATIN NAME	ALASKA NATIVE NAME	ALASKA NATIVE LANGUAGE
1. Horned Grebe	***Podiceps auritus*** *podiceps* - "rump-footed" *auritus* - "eared"	**toqa' vichidi** "red-necked grebe s younger brother"	Ingalik Athabaskan
2. White-fronted Goose	***Anser albifrons*** *anser* - "goose" *albifrons* - "white forehead"	**K'idot'aa-gga'** "bare-beak" ref	Koyukon Athabaskan
3. Mallard Derived from old French, it refers to "maleness".	***Anas platyrhynchos*** *Anas* - from *natare*, which means "to swim" *platyrhynchos* - "flat-beaked"	**Keenaadachuh** "flies straight up in the air"	Tlingit
4. Scaup Refers to birds that feed on "scamps" or "scalps" (an early name for scallops).	***Aythya spp.*** *Aythya* is a water bird mentioned in Homer s *"Odyssey"*.	**tontseedla** "stays in water"	Koyukon Athabaskan
5. Harlequin Duck A "harlequin" is the name of a character in old Italian comedies who wore a mask and colorful tights.	***Histrionicus histrionicus*** *Histrionicus* - "stage players"	**taa'sa hut'aana** "lives in whitefish lakes"	Koyukon Athabaskan
		"fish person"	Ingalik Athabaskan
6. Bald Eagle The white head of this eagle appeared bald.	***Haliaeetus leucocephalus*** *Haliaeetus* - Greek for "sea eagle" *leuco* - white *cephalus* - head	**ch'aak** imitates the sound made	Tlingit
7. Ptarmigan	***Lagopus spp.*** "hare-footed"	**dibaaga** imitates sound made by willow ptarmigan	Koyukon Athabaskan
8. Lesser Golden Plover	***Pluvialis dominica*** *Pluvialis* - "rain-bird" It was thought that these birds came to England in the rainy season *dominica* - "from Santa Domingo"	**bibidisis** "bear belly"	Koyukon Athabaskan
9. Yellowlegs	***Tringa spp.*** Greek for "waterbird with a white rump"	**dzolnolga** "long legs"	Koyukon Athabaskan
10. Bonaparte's Gull Charles Bonaparte, Napoleon's younger brother, was an American ornithologist.	***Larus philadelphia*** *larus* - "ravenous seabird" *philadelphia* - "from philadelphia"	**Veelzina** "black head"	Koyukon Athabaskan
		vitheizring "his head is black"	Ingalik Athabaskan

WETLAND WORTH



Objective

Students will become aware of the economic values of wetlands by classifying commercial, recreation, and subsistence uses of wetlands.

Method

Students will work in groups to develop lists of how people use wetlands. They will categorize their lists into commercial, recreational, or subsistence uses and brainstorm items that represent the different uses that could be included in a time capsule.

Background

Wetlands are important economically to a large and diverse population of Alaskans. **Economics involves the use and exchange of money or materials.** Generally, direct economic uses can be categorized into three different types: commercial, recreational, and subsistence. Commercial uses involve the exchange of money, for example, the sale of fish to a cannery or the sale of wetland animal furs such as beaver. Recreational uses imply enjoyment, but they may also involve an economic exchange when people buy fishing gear for sport fishing or cameras for wildlife photography and bring back items for sale or exchange. Subsistence use may involve little exchange of money and the plants, fish, and wildlife harvested are not sold. But the harvested resources may be traded, bartered, or given as gifts in a complex traditional system of exchange. Fishing, hunting, trapping, photography, basket-making, and berry picking are just some of the activities that generate money or products for families, guides, people who have jobs related to wetland resources, and private companies who market items that require wetland resources.

Economic exchanges are not

Subjects: science, language arts
Skills: classifying, discussion, group cooperation
Duration: one class session
Group Size: whole class, three to four groups
Setting: indoors
Vocabulary: economics, commercial, recreation, subsistence
Topics: conflicting points of view, conservation, hunting, habitat loss, interdependence, laws and regulations, people and wildlife sharing environments, responsible human actions

always direct. For example, wetlands have **passive economic values**. They "save" money by filling functions that would require the exchange of money and goods if wetlands were absent. For example, when wetlands store flood water, the cost of building dams is avoided as well as the cost of repairing flood damage.

Water itself is a **good** (ie, a commodity) in the sense that it is bought and sold in many places in the world, particularly where unpolluted sources of water are not abundant. It is also bought and sold in large quantities in the form of water rights. The anticipated amount of water available as stream or river flow is allocated among users such as farmers who irrigate crops, power companies who use it to generate power, pulp mills and other processing plants that use water, and local governments who distribute water to homes and commercial buildings. Thus, as wetlands function to store and purify water, they have yet another type of economic value which would be more noticeable if the wetlands were absent.

Materials

- Paper and pencil for each group

Procedure

1. Tell students that they will be learning about different types of uses and services of wetlands. Divide students into groups of three or four. Give each group five minutes to develop a list of ways people use wetlands and the services wetlands provide people. Have each group share their ideas and generate a class list. Discuss which uses are **economic**, uses that involve the use or exchange of money or things between people.

2. Ask whether they thought of uses or services provided by wetlands that avoid the outlay of money (flood storage, water purification). Ask students if they can think of a way to categorize the different direct economic uses. Suggest that they can be divided by commercial, recreational, and subsistence uses. Define each term.

3. Ask the groups to place the class list of uses into the commercial, recreational, or subsistence use categories. Then list the uses where money is saved by people because wetlands exist. Have students come up with a list of items that represent these uses and services that could be included in a time capsule to be opened far in the future. One example is a shotgun shell. This could represent recreational or subsistence hunting in a wetlands. Other ideas that students may develop include: can of clam chowder, commercial and sport fishing lure, camera lens or film, woven basket, blueberry muffin or jar of jam, trap, smoked salmon, binoculars, field guide for birds or wetland plants, book of nature poetry, old Pepsi can (to show inappropriate use of wetlands), sport fishing or hunting license, duck stamp, brochure of outfitter that uses wetlands, etc.

4. Have each group share the items that they would include in their time capsule. Discuss the "value" of wetlands. Lead students to discover non-economic values (aesthetic area for inspiration or writing, place to view wildlife, area to be alone) as well as direct and indirect economic values (commercial and subsistence fishing and hunting, wildlife photography, subsistence food gathering, guiding, etc.). Discuss whether wealth only deals with money or if it includes the material goods and services and non-material things a person has.

Evaluation

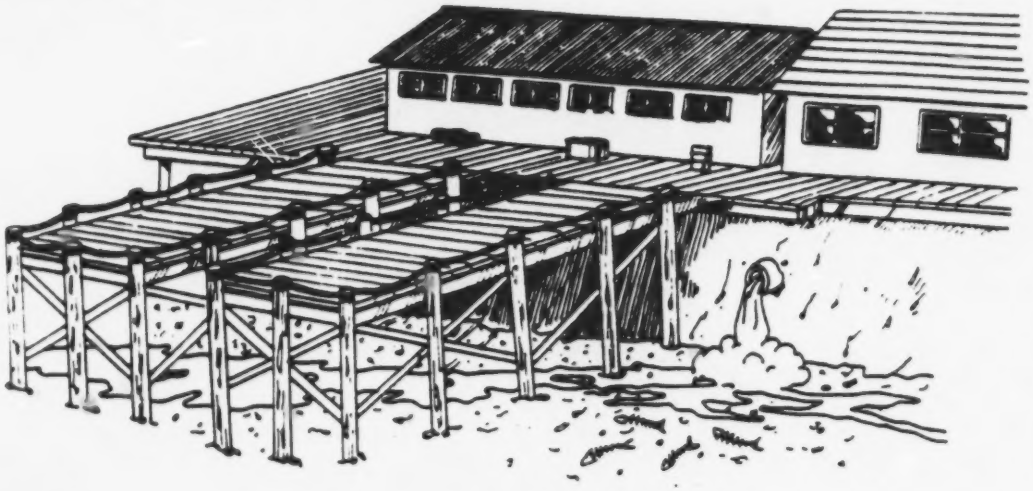
Did the group lists address the uses and therefore the economic values of wetlands?

Extensions

1. Have students think about what kind of information they would want future generations to know about wetlands. What are some important aspects of wetlands that they would want to express and how would they relate it?

2. Carry out an economic study of a local wetland. Have the students survey members of the community to find out how often they use it, what uses they make of it, and then develop estimates of how much people spend and what amount of goods they "harvest" from the wetlands.

DEADLY WATERS



Objectives

Students will:
1. Identify major types of aquatic pollution.

2. Make inferences about the potential effects of a variety of aquatic pollutants on wildlife and wildlife habitats.

Method

Students will analyze the pollutants found in a hypothetical river. They will graph the quantities of pollutants and make recommendations about actions that could be taken to improve wetland habitat.

Background

Wetlands and waterways, like rivers, lakes, and streams, are a vital expression of the water cycle. All the rain and snow that falls on the land either seeps into the water table or is carried to the sea. It collects in wetlands. In addition, all along the way water evaporates or finds its way back through plants and transpires back into the atmosphere to form clouds and precipitate again. Because all the water that has ever been available to our planet is on or in the earth right now, the atmosphere, oceans, and land form a single gigantic global water system.

With this picture of the interconnectedness of our planet's fresh water resources in mind, it is apparent how fragile this vital substance is. Yet each day water is being damaged by pollution - pollution that stresses ecosystems beyond their capacities to support life.

Pollution is a complex topic. **Water pollution** is defined as harmful substances deposited in water or other adverse changes in qualities of the water. Pollution can reduce or eliminate beneficial uses of water such as fish and wildlife habitat and human uses of water for drinking, cooking, irrigation, recreation, and transportation.

Substances or changes that pollute the water can be caused by

Subjects: science, social studies, health, home economics, industrial arts
Skills: analysis, classification, comparing similarities and differences, computation, description, discussion, identification, inference, interpretation, matching, media construction, observation, psychomotor development, reading, recognition, small group work
Duration: one to two class sessions
Group Size: small groups
Setting: indoors
Vocabulary: pollution, chemical, thermal, organic, ecological, point and non-point pollution, groundwater, toxic wastes
Topics: water pollution, toxicity

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human activities or by natural processes and events. Human activities which can cause pollution include agriculture, logging, mining, oil development, industrial development, sewage disposal, and garbage dumps however, when these activities are conducted properly, pollution can be avoided or reduced to low levels. While human activities are a major source of pollution, many natural events (such as avalanches, forest fires that lead to soil erosion, volcanoes, earthquakes, and natural oil seeps) also result in changes in water quality.

Regardless of the source of the change, changes in water quality can be harmful or beneficial to wildlife and wildlife habitat. The natural cycle of flooding which may wash out some duck nests during early summer also bring nutrients into ponds that fuel a more productive food chain.

Examples of the types of pollutants usually introduced by humans include:

Chemical Pollution: the introduction of toxic substances into an ecosystem, for example, acid rain, pesticides, petroleum products.

Thermal Pollution: varying temperatures above or below the normal condition, for example, power plant turbine-heated water.

Organic Pollution: oversupplying an ecosystem with nutrients, for example, fertilizer inflow.

Human activities can also result in changes in the concentrations of natural substances such as sediment or salt. These substances are considered to be pollutants when human activities add them to the ecosystem in abnormally high concentrations or inject them where they have never occurred. Natural processes can also result in abnormal concentrations. For example, salt water overflows into areas infrequently on extremely high tides and flooding causes higher levels of sediment in some areas. Regardless of the source of the change, the changes in water quality can be harmful or beneficial to wildlife and wildlife habitat. The flooding which may wash out some duck nests during early summer also brings nutrients into ponds that fuel a more productive food chain.

Understanding pollution's effects and causes prepares us to be able to take constructive action now and in the future to protect and maintain a healthy environment. The effects of any kind of water pollution depends on the severity of the pollution, the length of time over which the pollution occurs, the time of year, and the presence of other pollutants.

Documentation of human illness and death due to pollutants is overwhelming. Research shows that pollution also causes illness and death in wildlife. Wetlands have a capacity to filter some pollutants such as sediments and detoxify others. In some areas, they are used as sewage treatment areas. However, pollutants can overwhelm this natural capacity. The heavy metal contamination of wildlife refuges in the Central Valley of California illustrates this limit. At Kesterton National Wildlife Refuge, the high concentrations of selenium occurred in agricultural runoff because farming methods disturbed soil layers below the surface where selenium occurred. When the runoff reached downstream wildlife refuges, it caused a high incidence of deformities in newborn waterfowl and many deaths.

Some pollutants enter water from a localized source, like a chemical discharge from a factory or heated water output from a power plant. This is called **point source pollution**. Other pollutants enter from a variety of less easily identified sources; for example, rain washes motor oil left from dripping cars off store parking lots or when pesticides run off of farm fields. This is called **non-point source pollution**.

Pollution can be direct or indirect. Many different substances can alter water in ways that make it a hazard to wildlife, wildlife habitat, and to humans as well. The major purpose of this activity is for students to increase their understanding of water pollution and its potential effects on human and wildlife habitats.

Materials

- eight different colors of construction paper (2 sheets each)
- writing or graphing paper
- scotch tape or glue
- paper punch
- Pollutant Information Cards (one set for each group)
- 1 tablespoon

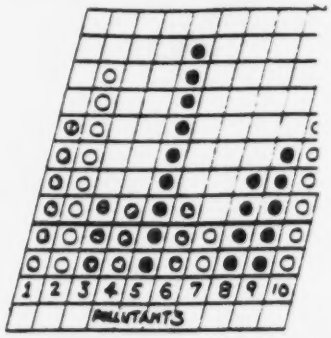
Procedure

1. Before the activity begins, make 100 tokens of each of the eight colors of construction paper. The construction paper may be folded in quarters to speed up the process of cutting or punching. Punch out construction paper tokens with a paper punch. Put all the tokens in a container. Stir them so the colors are thoroughly mixed. Make one copy of the Pollutant Information Cards for each group.

2. Divide the class into teams of three and pass out the Pollutant Information Cards. Review the three major types of pollution (chemical, thermal, organic) with the students. Talk about how some of the different types of pollutants described on the cards can fit into more than one of the three kinds of pollution. Explain that naturally-occurring substances such as sediment can be considered a pollutant if it is "out of place" or at abnormally high levels. Color code each type of pollution with a different color of the construction paper. Write a short description of the pollution on a piece of paper of the color to which it is coded. (Or, copy the Pollutant Information Cards, cut the descriptions apart, and paste the appropriate paragraphs on each of the colored sheets of paper.) Post each sheet of colored paper with its corresponding description of the kind of pollution it represents in a row in a convenient place.

3. Once all the kinds of pollution have been discussed and the students understand that each kind of pollution will be represented in this activity by one color of paper, explain that each group is a research team. Each team will analyze the pollution content of a hypothetical stream that flows into a wetland. Distribute the colored paper tokens that have been cut or punched from the construction paper. Provide 1/4 teaspoon of the paper-punched tokens to each research team. Also provide each team with a piece of graph paper.

4. The teams must separate the colored tokens into piles; using the color key, they should identify each type of pollutant. Once this is done, they should count the number of each kind of pollutant they have identified and then use graph paper to construct a simple bar graph showing the whole array of pollutants. Tell them to arrange the pollutants in the same order as they are displayed in the color key that is posted in the classroom. This makes it easy to compare each team's findings. Remind them that each of them has a different river. Their results are not likely to be the same!



5. When they have the bar graphs completed and have compared the teams' results, tell them that any quantity above two units of each kind of pollutant is considered damaging to wildlife or fish habitat. Have them read the information on the back of their Pollution Information Cards. (You could assign specific pollutants to each group and have them present a summary to the class.)

6. Discuss the following: in their hypothetical rivers, what pollutants would be likely to cause the most damage to wildlife and wildlife habitat? What human or nonhuman activities might be the source of the pollutants?

7. Have the students brainstorm which of the pollutants could have been at high levels because of natural processes (increased temperature - volcanoes; increased sediment - floods, glacial melt; oil pollution - natural oil seeps; acidic water - drainage from bogs; heavy metals - drainage from concentrated mineral deposits). Ask them how they would design experiments to determine if the level of pollutants was caused by a specific human activity or by natural processes (compare water samples upstream and downstream from the human activity and from the suspected natural cause). How could they determine the cause if the suspected source of pollution was far from the stream (trace the flow of water in the watershed, "label" the pollutant somehow, for example, with dye or radioactive elements)?

8. Ask the students why humans should be concerned about pollutants that enter the food chain and affect fish and wildlife. (Humans are the ultimate consumer in the food chain and will also suffer harmful effects.)

Reference

Aquatic Project WILD. 1987. "Deadly Waters." Western Regional Environmental Education Council.

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Extensions

1. List five things you can do - starting today - in your own life to reduce the number of pollutants you add to the environment.

2. Identify any pollutants that might be affecting a local stream or wetland, based on the land uses going on upstream or next to the wetland. If possible, take a field trip to sample water quality (see the How To Information Sheets and Wetland Field Study Sheets in the Field Trip Manual for information about sampling water quality). Contact local officials responsible for water quality (representatives of the Alaska Department of Environmental Quality or municipal or city engineers) and ask them the levels of specific pollutants they have measured and any actions they have taken to reduce the level of pollution if it is high.

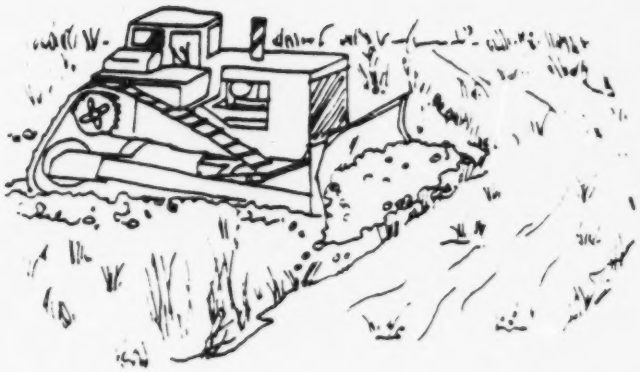
3. Set up a long-term water quality monitoring program on a local stream or wetland. See the References section for sources of information on how to do this.

4. Get information about current national laws protecting water quality by writing to the Environmental Protection Agency. Or, write to the Alaska Department of Environmental Conservation to get information on state laws.

5. Write the Alaska Department of Environmental Conservation for a unit on Safe Drinking Water in Alaska. (K-3 and 4-6 units.)

TYPE OF POLLUTION: SEDIMENT

Particles of soils, sand, clay, and minerals wash into streams and rivers. In large quantities, these natural materials can be considered a pollutant.



EXAMPLES OF HUMAN ACTIVITIES THAT CAN RESULT IN SEDIMENT POLLUTION: Construction projects that clear land (i.e., building roads, houses, businesses, airports), removal of trees for timber harvest, placer and strip mining, agriculture, building dams or other structures to control water flow.

PREVENTION: Leaving strips of trees and plants around cleared or logged areas, settling ponds.

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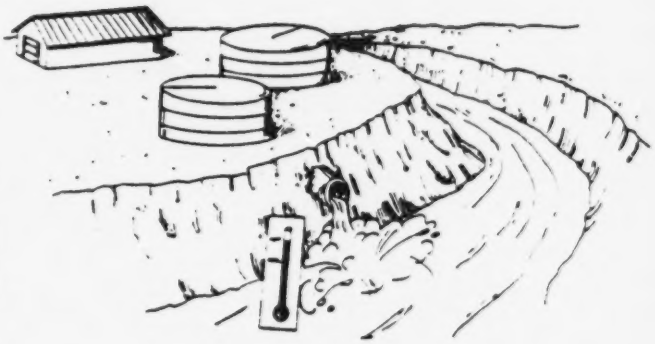
SEDIMENT POLLUTION

EFFECTS ON FISH AND WILDLIFE: High concentrations of suspended sediment can block sunlight from reaching plants in the water. Plants grow poorly and provide less food for invertebrates, fish, and birds. Reduced light can make it difficult for fish to see and capture their food. Silt can damage or clog the gills of fish and invertebrates. Extremely high levels of silt that drops out of the water cover gravel on the bottoms of rivers and streams with mud. Animals that live on gravel can't survive. Fish such as salmon that spawn on gravel no longer have habitat for laying their eggs. Fish eggs, shellfish, and invertebrates in the gravel can be smothered.

TYPE OF POLLUTION: THERMAL (WATER TEMPERATURE CHANGE)
A change in normal water temperature is considered thermal pollution.

EXAMPLES OF HUMAN ACTIVITIES THAT CAN RESULT IN WATER TEMPERATURE CHANGES: Discharges from power plants, removal of trees along streams during logging that provide shade during logging, discharges from sewage treatment plants during winter, burial of heated or cooled oil or gas pipelines under rivers and wetlands.

PREVENTION: Cooling water before discharge, leaving strips of trees for shade, insulation of heated or cooled pipelines



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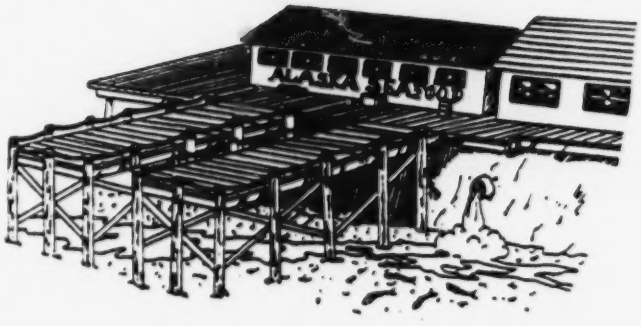
THERMAL POLLUTION

EFFECTS ON FISH AND WILDLIFE: Very hot water can kill some fish such as trout, salmon, grayling, and whitefish and invertebrates that normally live in cooler water. Hot water can kill fish eggs and kill or harm developing embryos. Increases or decreases in water temperature can change the pattern of freezing and thawing, harming animals adapted to a normal pattern. Fish may lay eggs or insects emerge as adults at the wrong time of the year when no food is available or conditions are poor for survival. Water temperature changes can affect the entire food chain if plant growth is affected.

TYPE OF POLLUTION: ORGANIC
Organic wastes consist of materials that were once alive.

EXAMPLES OF HUMAN ACTIVITIES THAT CAN RESULT IN ORGANIC POLLUTION: Direct discharge of sewage into streams or wetlands, discharge of large quantities of fish wastes from processing plants, discharge of logging wastes from harvest areas and pulp mills.



PREVENTION: Treatment of sewage or other wastes or disposal where the water system is not overloaded.

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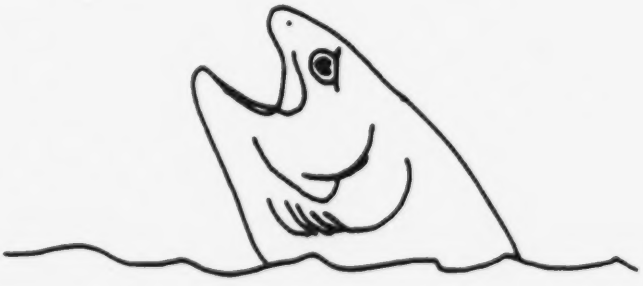
ORGANIC POLLUTION

EFFECTS ON FISH AND WILDLIFE: Bacteria that breaks down sewage, fish wastes, logging wastes and other organic matter use up the oxygen in the water. Few types of living things can live where levels of oxygen are very low. Fish damage their gills, grow slowly, have delays in the hatch of their eggs, and may die as a result of low oxygen levels. Decay of material without oxygen produces toxic substances that kill many invertebrates and fish. Organic wastes can also act as fertilizers.



EFFECTS ON HUMANS: Sewage that has not been treated may carry harmful bacteria and cause sickness in humans exposed to it by swimming or by drinking the water

TYPE OF POLLUTION: OIL AND OTHER PETROLEUM PRODUCTS

Oil is a very visible pollutant at high concentrations. Since most petroleum products are less dense than water, they float and are often visible as a sheet or sheen on the water surface. Tiny particles of oil may be suspended in water that is mixed thoroughly (by wind, waves, or agitation). Spilled oil that "disappears" may often still be present in a suspended state or as a coating on the bottom of a water body.

EXAMPLES OF HUMAN ACTIVITIES THAT CAN RESULT IN OIL POLLUTION: Disposal of oil in water or onto wetlands (e.g., draining a car's oil), spills during development, storage, or transportation of oil, leakage from underground tanks.

PREVENTION: Using disposal areas that are not connected to streams or wetlands, avoiding spills.

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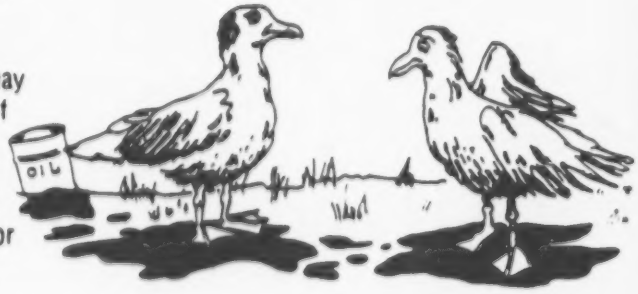
OIL POLLUTION

EFFECTS ON FISH AND WILDLIFE: The effects of oil on wildlife vary considerably with the type and concentration of spilled oil. The volatile (gaseous) portions of the oil which evaporate rapidly from spilled oil are very poisonous to fish, some invertebrates, birds, and mammals. High concentrations of oil can slow the growth of plants.



An oil slick on the water surface blocks sunlight and may affect plants in the water. Oil which sticks to the gills of fish can interfere with their breathing. Oil sticks to the feathers of birds and fur of mammals and ruins their insulation and ability to avoid freezing to death in cold water. Some animals which try to clean their feathers or fur swallow the oil and are poisoned. Floating oil can become a coating on sand or soil particles and sink to the bottom as the particles settle. Oil that reaches the bottom of a stream or the ocean may smother invertebrates that live on the bottom (including crabs and shrimps) and prevent fish from spawning. Oil which reaches wetlands and beaches may smother or poison plants and invertebrates and stay around for many years. Oil enters the food chain as predators feed on other animals that were poisoned by oil.

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TYPE OF POLLUTION: TOXIC SUBSTANCES

A wide variety of chemicals, including pesticides and herbicides, and waste products are toxic or harmful to different types of fish and wildlife. Many are also toxic to humans.

EXAMPLES OF HUMAN ACTIVITIES THAT CAN RESULT IN TOXIC POLLUTION: Agriculture, gardening, forest management, clearing land, mosquito control, discharge of detergents, mining, manufacturing.

PREVENTION: Finding and using non-toxic alternatives, using and disposing of chemicals in such a way that they will not enter water.

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TOXIC POLLUTION

EFFECTS ON FISH AND WILDLIFE: Some pesticides and herbicides applied to crops, gardens, forest stands, or other areas of land to eliminate undesirable plants or animals break down into non-toxic chemicals. Others spread to lakes, rivers, and wetlands. While effects vary widely, both pesticides and herbicides are designed to be poisonous. A few are poisonous to a fairly specific groups of insects or plants, while many are poisonous to a wide variety of invertebrates, fish, mammals, and amphibians. The poisons may cause immediate death, cause illness, or interfere with an animal's abilities to survive or to reproduce. Some substances reach higher concentrations as they are passed up the food chain.

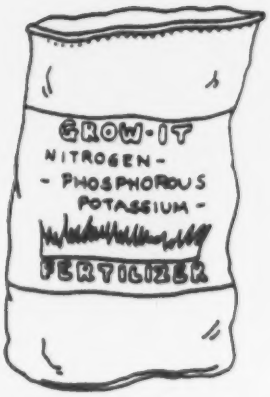
Other toxic substances are introduced into waters if they are disposed of improperly. Mining and manufacturing wastes may include highly acidic substances or chemicals such as arsenic used in the mining process.

Wetlands can immobilize some pesticides and other toxic substances and keep them from spreading into the food chain.

TYPE OF POLLUTION: FERTILIZERS
Fertilizers contain often large amounts of nitrogen and phosphorus, nutrients which are usually limited in most ecosystems.

EXAMPLES OF HUMAN ACTIVITIES THAT CAN RESULT IN FERTILIZER POLLUTION: Agricultural and gardening run-off, discharge of nutrient-rich water.

PREVENTION: Preventing run-off into streams and wetlands that will become overloaded by the nutrients.



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FERTILIZER POLLUTION

EFFECTS ON FISH AND WILDLIFE: Fertilizers contain nitrogen and phosphorus that can cause large amounts of algae to grow. If the large blooms cover the water's surface, the algae die after they have used up all of the nutrients. Once dead, they sink to the bottom where bacteria feed on them. The bacteria increase and use up most of the oxygen in the water. Many animals die without oxygen.

High concentrations of nitrogen in the form of nitrates or ammonia are toxic to young animals.

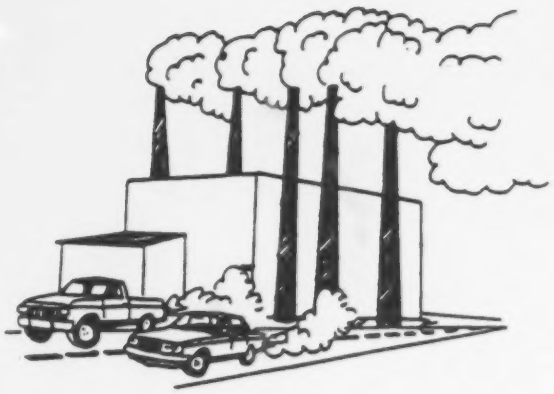
Wetland plants can absorb excess nutrients and convert nitrogen compounds into non-toxic forms.

TYPE OF POLLUTION: CHANGES IN ACIDITY (pH)

pH is a measure of the acidity (low pH) or alkalinity (high pH) of waters. Values of either too high or too low pH will affect organisms living in the water.

EXAMPLES OF HUMAN ACTIVITIES THAT MAY RESULT IN ACID PRECIPITATION: Air pollution resulting from burning of fossil fuels.

PREVENTION: Reduce burning of fossil fuels through energy conservation, install pollution control devices on smokestacks.



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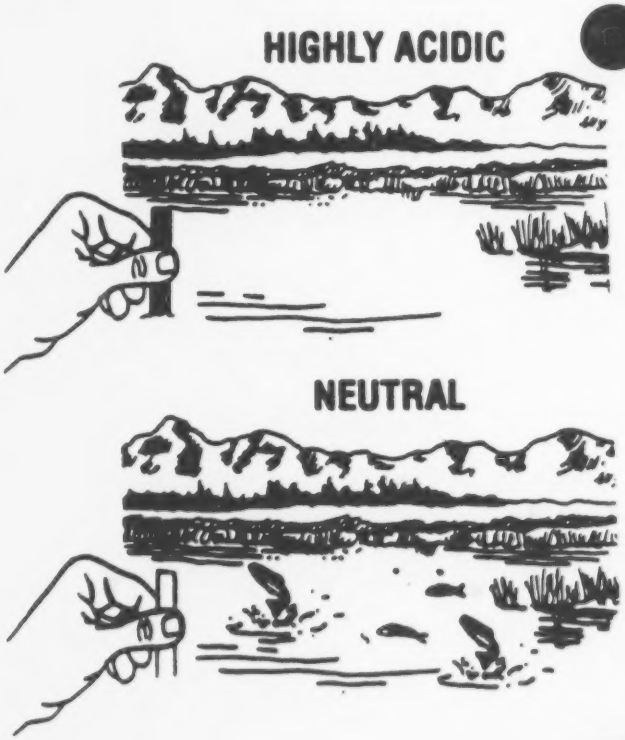
ACID PRECIPITATION POLLUTION

EFFECTS ON FISH AND WILDLIFE: As the acidity of water increases, naturally occurring mercury and other heavy metals can be released, resulting in changed chemical qualities of the water. When water becomes too acidic, some fish and aquatic insects die. Loons and other waterbirds can be poisoned by mercury-contaminated foods.

Acid precipitation and the dying of lakes and forests is becoming a serious problem in Scandinavia, Europe, and eastern Canada. Pollution of the air over arctic Alaska has already been measured.



TYPE OF POLLUTION: HEAVY METALS
Zinc, cadmium, copper, lead, mercury, selenium

EXAMPLES OF HUMAN ACTIVITIES THAT MAY RESULT IN HEAVY METAL POLLUTION: Disposal of mining wastes, agricultural runoff, use of lead shot to hunt waterfowl, garbage dumps, atmospheric pollution.

PREVENTION: Avoid disposal and runoff into streams and wetlands, substitute steel shot for lead shot, treat wastes to remove heavy metals or convert them to less harmful forms.

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HEAVY METALS POLLUTION

EFFECTS ON FISH AND WILDLIFE: The poisonous effect of various heavy metals varies considerably with concentration, water temperature, amount of oxygen in the water, and pH. Vertebrate animals seem in general to be more sensitive than invertebrates which may concentrate the metals in the food chain.

High concentrations of cadmium, zinc, and copper have caused behavior changes and reduced reproductive ability in fish.

Mercury compounds are toxic to most fish and other aquatic life, can be passed up the food chain, and in high concentrations can cause brain damage to humans.

Ingestion of lead can result in poisoning and death of waterfowl and can concentrate up the food chain and cause the death of eagles and other birds of prey. See the brochures "Lead Poisoning in Waterfowl" and "Shoot Steel Shot" for more information.

Selenium pollution has resulted in poor reproduction and abnormalities of embryos of waterfowl.

A WETLANDS VISIT

Procedure

1. Assign students in your class to each of the "parts" in the cast of "A Wetlands Visit." Their role is to say their line (words in parentheses) whenever their part is mentioned.

Cast:

wildlife photographer (say cheese! click)
mallards (quack, quack)
footsteps (squish, squish)
Canada geese (honk, honk)
water (gurgle, gurgle)
mosquitos (buzzzzz)
beaver (slap!)
water strider (move arms silently like a water strider)
moose (clomp, clomp, clomp)

2. Read the story on the following pages aloud, pausing for the sound effects of the cast.

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A Wetland Visit

We wanted to get up early for our hike to (name of local wetland) (type of wetland) near (name your town). My friend was determined to become a **wildlife photographer** (say cheese! click). At the crack of 10:00 am., we headed out. As we got close to our destination, we heard the faint sound of **mallards** (quack, quack) getting closer. We walked quietly, but we could still hear the sound of our own **footsteps** (squish, squish) in the grasses and wet ground. Overhead, a huge flock of **Canada geese** (honk, honk) could be heard calling noisily. When we reached (name of local wetlands), we sat quietly at the edge where we were hidden by the willows and alders. We sat as quietly as possible and listened carefully. At first, all we heard was the **water** (gurgle, gurgle) gurgling. The **wildlife photographer** (say cheese! click) readied her camera. The **mosquitos** (buzzzzz) soon found us and distracted our attention away from a **beaver** (slap!) that was quietly swimming our way. I turned my head and saw small waves of **water** (gurgle, gurgle) rippling in the quiet, deep pool on the other side. The **beaver** (slap!) seemed to suddenly notice our presence and its broad, flat tail slapped the **water** (gurgle, gurgle). At the same time, the **wildlife photographer** (say cheese! click) missed an incredible photo opportunity while doing some slapping of her own. The **mosquitos** (buzzzzz) were getting ferocious!

The **water** (gurgle, gurgle) continued to keep us company and the sound of the **beaver** (slap!) seemed long gone. I was doing my best to keep quiet but the **wildlife photographer** (say cheese! click) was unwrapping a noisy piece of candy. I glanced down at the **water** (gurgle, gurgle) and noticed a **water strider** (strider motions) skating on top of the **water** (gurgle, gurgle).

I was wondering how it could accomplish such a feat. The **water strider** (strider motions) just kept moving across the **water** (gurgle, gurgle). **Water striders** (strider motions) look rather silly, I think.

The **wildlife photographer** (say cheese! click) was getting impatient by now and started to get up just as a flock of **mallards** (quack, quack) flew by. The **mallards**

(quack, quack) were startled by the sudden movement and veered out of camera range. The **mosquitos** (buzzzzz) were really getting out of hand now. My friend slumped down dejectedly and her camera lens fell into the **water** (gurgle, gurgle) below. As she was retrieving the lens, I noticed a big **moose** (clomp, clomp, clomp) walking towards us. The **moose** (clomp, clomp, clomp) was slurping down plants and **water**. I grabbed the arm of the **wildlife photographer** (say cheese! click) to get her attention and startled the **water strider** (strider motions) she was attempting to photograph. The **moose** (clomp, clomp, clomp) munched on some willows. My friend, after finally finding her lens cap, shouted, "I found it!"

The **moose** (clomp, clomp, clomp) lumbered out of the **water** (gurgle, gurgle) and trundled off into the bushes before the **wildlife photographer** (say cheese! click) could focus for a picture. The **beaver** (slap!) that had ventured by again ducked underwater in search of more quiet surroundings.

The **water** (gurgle, gurgle) kept up its music as we decided to follow our **footsteps** (squish, squish) home. We walked as quietly as possible to try for another chance to photograph some wildlife. Only our **footsteps** (squish, squish) betrayed our presence. When we turned around to look behind us, we saw the sunset. The sun was low on the horizon and the sky was glowing pink and gold. High overhead we heard the flock of **Canada geese** (honk, honk). I slipped my friend's camera out of her backpack, held it up and said to the mighty **wildlife photographer** (say cheese! click).

Unit 4 — Issues, Problem-Solving, and Action Projects

Page

Where Do You Draw The Line? — Wetlands 82
Students listen to a statement, decide their opinion about it, then place themselves on a line according to their opinion.

Decision Dilemmas 84
Students read, discuss, make judgments, and write about hypothetical dilemmas concerning wildlife and/or natural resources.

Who's Side Are You On? 89
Students read and analyze "newspaper articles" written for this lesson.

Who Does What? — Wetlands 94
Students play a card game to learn the functions of various organizations which participate in management decisions affecting wetlands.

Putting It All Together 99
Students go through a problem-solving process using a local issue.

Can Do! — Wetlands 103
Students select a school environmental project, conduct research, make plans, and follow procedures to accomplish the project.

ISSUES, PROBLEM-SOLVING AND ACTION PROJECTS

Human problems arise when a situation or condition exists in which someone or something is threatened. **Environmental problems** are when people become aware that some part of the environment is changing and which affects some of their values. Environmental problems become **issues** when two or more people or groups of people disagree about either the scope or seriousness of the problem or about the appropriate solution. **Environmental problem-solving** is usually directed at devising a solution which either eliminates or reduces the threat or repairs environmental damage.

Individuals or groups of people who take part in the problem or its solution are the **players** who take a **position** or stand with regard to the problem or its solution.

Problems and issues that focus on wildlife and their habitat are really human problems, sometimes faced by a community or society as a whole, and sometimes faced by individuals. For example, human decisions and actions are needed when humans desire more or less wildlife. In Alaska, people often disagree about which species they would like more or less of (for example, hunters may want more moose, where wildlife viewers would like more bears) or the appropriate way to achieve the desired result (for example, acceptable methods of eliminating bears from an area).

Human decisions and actions can also indirectly result in fewer wildlife if land is developed in such a way that wildlife is harmed or wildlife habitat is eliminated. As an example, a major issue in Alaska, where so much of the area is wetlands, concerns a disagreement about the scope and seriousness of negative impacts from various types and degrees of development on wetland values such as wildlife habitat.

In fact, the majority of wildlife habitat issues arise in the context of land use decisions. In our democratic country, whenever public land is involved or the public has an interest in the outcome, citizens usually have an opportunity to become involved in the decision. Private citizens also address problems and make individual decisions which affect wildlife - where and how to dispose of pollutants, what type of lifestyle to live in terms of consuming non-renewable resources which may have been developed at the expense of wildlife habitat. In either case, the ability to gather and evaluate relevant information, to form opinions, to communicate, and to take responsible actions are essential to responsible participation in the decision-making process and problem-solving.

The position taken by a person on an issue is directly related to personal **beliefs** and **values**. **Beliefs** are ideas which a person believes are true even though in reality they may not be true. Many beliefs cannot be supported when the process of scientific reasoning and testing are applied. Often, a person's beliefs are strongly related to his or her values. A **value** is the comparative worth a person places on something. Each individual has personal values which develop in response to past experiences. These values may involve money, or beauty, or a number of other things.

Beliefs and values help people make decisions and choices when the possible answers are not clearly right and wrong, as is often the case with environmental issues

The activities in this unit are designed to give your students opportunities to become involved in issues affecting wildlife and wetlands. **Putting It Together** describes how to structure a problem-solving unit and includes references for such a unit focussing on a local wetland issue. **Decision Dilemmas** is designed to help students identify different types of values as they evaluate different types of actions involving wetlands and their impacts on the environment. **Where Do You Draw the Line?** provides opportunities for students to form and express opinions and to receive factual information which may modify their opinions. **Can Do** is a blueprint for community action projects.

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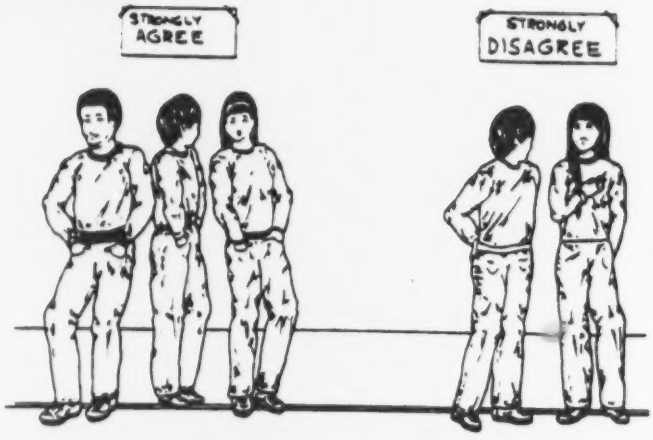
WHERE DO YOU DRAW THE LINE ? - WETLANDS



Objectives

Students will:
1. Form opinions about issues and explain their reasons for making choices.

2. Understand that different circumstances can change their opinions or actions.

Method

Students listen to a statement, decide their opinion about it, then place themselves on a line according to their opinion.

Background

The purpose of this activity is to encourage students to obtain information before forming an opinion. Teacher should stress that there is no right or wrong opinion about these questions. **Opinions based on logic, emotions, or philosophy are valid, as long as they are not based on incorrect information.** This activity is carefully written so that individual students will never be evaluated based on their opinions.

Materials

- masking Tape (15-20')
- "Strongly Agree" card
- "Strongly Disagree" card

Procedure

1. Place a long masking tape line on the floor (approximately 15 feet long). Put one card at one end, the other at the other end of the tape line. Read the first item on the list of statements. Students are to place themselves along the masking tape line according to their personal opinion of the statement. If they strongly agree with the statement, they stand closest to the "Strongly Agree" card, if they strongly disagree, they stand closest to the "Strongly Disagree" card. Students who have no opinion, or are somewhere in between a strong feeling and a neutral one can place themselves accordingly along tha line. After students stand along the line, they should explain their reasons for standing where they are. Encourage discussion among students. Remember: there are no "right" or "wrong" answers in this game, unless opinions are based

Subjects: social studies
Skills: decision-making, discussion, values clarification
Duration: one to two class sessions
Group Size: large or small
Setting: outdoors or indoors in gym or hallway
Vocabulary: values, opinion
Topics: value of wildlife to people, people and wildlife sharing environments

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on misinformation.

2. The following statements include "warmup" examples and examples concerning the environment for which there is a diversity of opinion. If the majority of students have similar opinions about a statement, using variations of each statement will help them become aware that opinions are seldom "black or white" and that specific situations and circumstances can cause people to modify their opinions.

For example:
Basketball is more fun than volleyball.
Variation: The basketball court is outside, the volleyball court is inside, and it's -30° F.

Cookies are better than ice cream.
Variations #1: A chocolate chip cookie is better than vanilla ice cream.
Variation #2: A fig newton is better than chocolate ice cream. If you're lost and starving in the wilderness in interior Alaska, and it's 80°F, would you rather have cookies or ice cream?

Ask the students to think of situations that would cause them to change their opinions.

Note: Some of the sample statements will be relevant to students living in urban environments in Alaska and some are relevant to Bush living. Choose the statements which are most familiar to your students and about which they are likely to have a range of opinions.

Statements:

- Basketball is more fun than volleyball.

- Cars are better than snowmobiles.

- Moose are better than horses.

- Cookies are better than ice cream.

- Playing basketball is more fun than playing baseball.

- Three-wheelers are better than snowmobiles.

- Bicycles are better than cars.

- Hunting is fun.

- Watching birds is fun.

- Walking in a wetland is fun.

- Walking in a wetland is interesting.

- People should never build roads across wetlands.

Variations:
- People should be allowed to build a road across one corner of a wetland.
- People should be allowed to build a road across a wetland if there is no other way to get somewhere.
- People should be allowed to build a road across a wetland if there is no other way to get to a good place to build a school (or a hospital, or an airport).
- People should be allowed to build a road across a wetland if it is their property and not owned by the state or federal government.

- People should never build airports in wetlands.

Variations:
- People should be allowed to build an airport in wetlands if that's the safest place to land planes.
- People should be allowed to build an airport in wetlands if it would cost a lot more to build it somewhere else.

- Ponds are better than muskegs.

- Floods are always bad for wildlife.

- Pollution should be stopped no matter how much it costs.

Reference

Project WILD. 1986. Western Regional Environment Education Council.

DECISION DILEMMAS

Objectives

Students will:

1. Examine their own values and beliefs related to wildlife and other elements of the environment.

2. Evaluate actions and their potential impact on wildlife and the environment.

Method

Students read, discuss, make judgments, and write about hypothetical dilemmas concerning wildlife and/or natural resources.

Background

The following activities are designed to help students identify different types of human concerns as they relate to decisions affecting wildlife and wetlands. It is not intended to prescribe "right" and "wrong" answers for the students, except in areas where information about laws is conveyed. Teachers are encouraged to have students do additional research about each dilemma, so that decisions are based on the best factual information available. The major purpose of this activity is to provide students with an overview of a wide spectrum of human concerns and the opportunity to form their own judgments about what they think would be the most responsible and appropriate actions to take in specific situations.

The following lists the types of human concerns that the Army Corps of Engineers is legally required to consider along with some other types of human concerns.

A. Concerns considered in the Corps of Engineers wetland permit review to determine the public interest.

conservation
economics
aesthetics
environmental

Subjects: social studies, science, language arts
Skills: analysis, application, discussion, evaluation, decision-making, problem-solving, group interaction, synthesis
Duration: one class session
Group Size: whole class and small groups of two to four students
Setting: indoors
Vocabulary: dilemma, responsibility
Topics: people and wildlife sharing environments, responsible human actions, conflicting points of view regarding natural resource issues

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fish and wildlife values
flood damage prevention
welfare of the general public
historic values
recreation
land use
water supply
water quality
navigation
energy needs
safety
food production

B. Other concerns upon which people base their decisions:

religious
cultural
political
social
educational
survival/physical health
scientific

Activity 1

Procedure

1. Read one or more of the following decision dilemmas to the students or adapt them to describe a wetlands permitting dilemma in your community. Do not read the possible solutions given, these are for your use in the discussion that will follow. After you have read each situation, ask the students to write down what they would do and why. Encourage creative alternatives that can maintain wetland values and allow human activities to occur. Give them three to five minutes to write their answers.

Dilemma 1

You own land and would like to build your home on it. You will need to place a pad of gravel on the land to provide a stable foundation for your house. You find out it is legally classified as a wetland.

Possible answers - FOR TEACHER USE IN DISCUSSION:
a. Find out which part of your land is used by fish or wildlife or has other wetland functions and plan your home for the area that has lower use or fewer functions.

b. Find out whether placing gravel on the wetland requires a permit

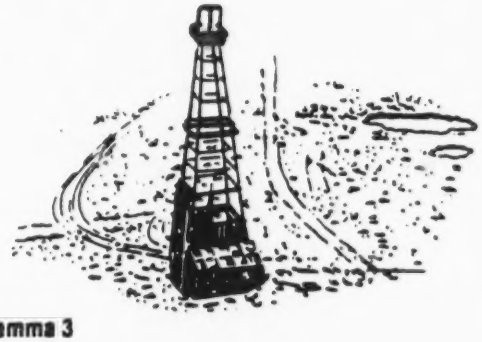
c. Apply for a permit.

d. Build your house without getting any permits.

e. Sell your land to someone else and buy another piece of land for your home.

Dilemma 2

Someone is planning to build an asphalt plant in a wetland in your community. They are also proposing to dispose of the oily wastes which the plant would generate in the wetland because taking the wastes somewhere else would be expensive. Because the wetland is on public-owned land, a hearing is being held to hear the concerns of the community. Would you testify in favor or against the project at the public meeting? Can you think of changes in the plan that might change your testimony?



Dilemma 3

You are the owner of an oil company that has leased part of the North Slope of Alaska. You plan to construct a gravel pad and drill an oil well on tundra wetlands. When you apply for a wetlands permit, you learn that the place you want to fill with gravel is very

important for nesting birds and feeding caribou in the summer. The gravel will destroy the habitat.

Possible answers - FOR TEACHER USE IN DISCUSSION

a. Study the area to find out if there is an area close by which is not as important for the birds and caribou where drilling the well would cause less harm to wildlife.

b. Find out whether it is possible to drill the well in a different location and how much more that would cost.

c. Follow your original plan and apply for permits.

d. Redesign the gravel pad to make it as small as possible.

e. Follow your original plan but offer to improve wetland habitat somewhere else.

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2. After the students have written down what they would do and why, ask them to go back and think about what types of information they would like to have to help them with each decision.

3. Ask the students to describe what they based their decision on. (Each dilemma should elicit a variety of responses.) Discuss the spectrum of values, emphasizing to the students that different types of concerns are often raised in trying to make a decision. When a group tries to make a decision together, everyone makes their decision based on an individual set of concerns and beliefs about what they think is true about the situation. Ask students how they would develop a common set of beliefs about a situation (find the information that each person wants to help make the decision through research or scientific investigation). How could they solve a problem if the players do, in fact, possess different concerns which may be in conflict? Someone has to decide what the best solution is, which is often a compromise.

4. Explain the process used by the Army Corps of Engineers and Environmental Protection Agency to decide whether or not to allow an activity to occur on wetlands. Their decisions sometimes preserve and sometimes destroy wetlands. To do this, they consult the public and many state and federal agencies in order to get information and advice about the value of a specific wetland in relation to the value of the construction project (i.e., what types of human benefits will occur) being proposed. They then weigh and balance the concerns and benefits. Using information from the table in the Background section, describe which of the reasons given by students for their decisions would be used by the Corps of Engineers to make their decision.

5. Have the students break into small groups of four to six and brainstorm whether or not they would issue a permit for fill of the wetland in each situation. Encourage them to list the benefits of each project to people as well as the negative impacts that might occur to the wetland.

Activity 2

Materials

- Decision Dilemma Cards

Procedure

1. Copy and cut up the Dilemma Cards. Other dilemmas could be written that are more specific to problems in your area. Students can also be involved in creating dilemma cards, with each student responsible for one card.

2. Divide the class into groups of four and give each group a stack of dilemma cards. Place the cards face down at the center of the group.

3. The first player draws a card from the top of the stack. The player has two minutes to study the situation, decide what he or she would do, and formulate reasons for the decision.

4. When the allotted two minutes is up, the player reads the situation and the options aloud to the rest of the group. The student gives the decision he or she has chosen and briefly describes the reasoning involved. In turn, each of the other members of the group is invited to comment on the dilemma and what he or she would do in the situation. The discussion of each dilemma by the members of the group should take about five minutes. The person whose dilemma is being discussed should have the opportunity to ask questions of other members of the group, and to offer clarification about his or her decision. The discussion gives the students experience in having ideas examined by peers, and is intended to remind the student of the need to take personal responsibility for decision-making. It is not necessary

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and may not be desirable for the students to reach consensus; there are legitimate ranging views of the most appropriate and responsible actions to take in many situations. The purpose is to provide students with an opportunity to examine, express, clarify, and take responsibility for their own reasoning.

5. The card is then returned to the bottom of the stack and the next player selects a card from the top of the deck. Continue this process until all students have had the opportunity to express their decision and rationale about a dilemma.

Reference

Project WILD. 1986. "Ethi-Reasoning." Western Regional Environmental Education Council.

Extensions

1. Do the activity "Fact or Feeling" from the Alaskanized version of CLASS Project.

Dilemma Cards

You are head of a task force created to select the best course of action to attempt to preserve the red-speckled goose. There are 200 birds left in a steadily declining population. Left to their own, it is probable they will all die. Some members of your task force would like you to authorize capturing some of the birds and sending them to zoos to try to propagate them in captivity.

Do you:
* leave them in their natural environment?
* capture some of them for zoos?
* other?

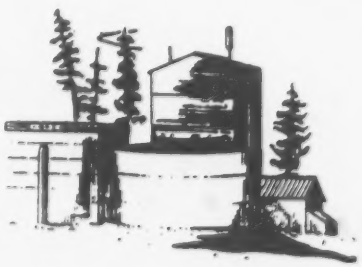
You have found a beautiful spot to build a home. One hillside of the property has a beautiful view and is your choice for your homesite. However, you discover there is an active bald eagle nest on that hillside. Bald eagles are sensitive to high levels of noise during nesting, and also to loss of their nesting sites or nearby perch trees. Bald eagles are highly selective in choosing nest sites and usually return to the same nest year after year. It is a protected species.

Do you:
* select a different site on the property to build your home?
* sell the property?
* chop down the trees and build your home?
* other?

You are on a field trip with your class to the zoo. Although you know that feeding the animals by zoo visitors is prohibited, some of your friends are feeding marshmallows to the bears.

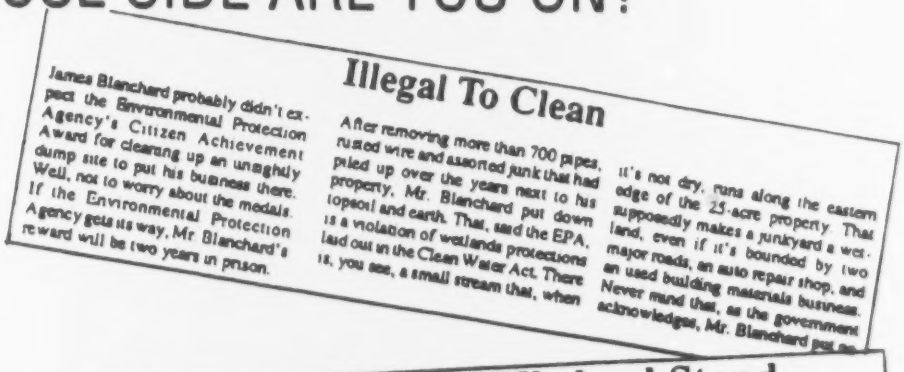
Do you:
* tell them that feeding marshmallows to the bears may harm them and ask your friends to stop?
* report their behavior to the nearest zoo keeper?
* ask the teacher to ask them to stop?
* not do anything?
* other?

You are logger and live in a remote logging camp. One day, you notice a leak in the large fuel storage tanks in the camp. Oil used for heating and cooking has been leaking for some time into a small marsh and stream next to the camp. When you point it out to your boss, he tells you not to report it or clean it up.



Do you:
* do what your boss tells you?
* insist the spill be cleaned up and volunteer to do it on your own time?
* report the spill anonymously to the Alaska Department of Environmental Conservation?
* report the spill to someone else in the company you work for who has responsibility for environmental protection?
* other?

WHOSE SIDE ARE YOU ON?



Illegal To Clean

James Blanchard probably didn't expect the Environmental Protection Agency's Citizen Achievement Award for cleaning up an unsightly dump site to put his business there. Well, not to worry about the medals. If the Environmental Protection Agency gets its way, Mr. Blanchard's reward will be two years in prison.

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Mr. Blanchard Mired In Wetland Stand

Martin Pundit, Syndicated Columnist

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Objective

Students will distinguish between facts and opinions related to environmental regulation.

Method

Students will read and analyze "newspaper articles" written for this lesson.

Background

In our democratic society with a free press, media accounts about environmental issues often present distinct points of view or "sides" to an issue. These accounts use colorful and persuasive language to convince readers. This activity is designed to help students become careful and discriminating readers. It is not intended to be a description of a real case.

Materials

- Copies of the articles: "Court Delivers Harsh Wetlands Verdict," "Illegal To Clean," and "Mr. Blanchard Mired In Wetland Stand."

Procedures

1. Ask your students the difference between facts and opinions. Develop a definition of each. Discuss the term "propaganda" and techniques used to persuade people of a particular point of view. For example, appeal to emotion by use of value-laden or emotion-laden words, selective use of facts, etc.

2. Have students take out a piece of paper and draw a line down the middle. Label one-half "facts" and the other half "opinions." Pass out copies of the articles and have the

Subjects: social studies, science, language arts
Skills: analysis, application, discussion, evaluation, decision-making, problem-solving, group interaction, synthesis
Duration: one class session
Group Size: whole class and small groups of two to four students
Setting: indoors
Vocabulary: facts, opinions, propaganda
Topics: people and wildlife sharing environments, responsible human actions, conflicting points of view regarding natural resource issues

students read all three articles. As they do so, have them list the facts and opinions they encounter in the appropriate column.

3. Divide the board in half to resemble the students' papers. As a class, compile the facts of the situation and write these in the "facts" column. If there is disagreement about whether a statement is a fact, have the class review the information until they agree on what is factual.

4. Ask for examples of opinions the students encountered. Write these on the board using the exact language as stated in the opinion.

5. Review the opinion statements with the class. Ask them if any of the words used are ones that appeal to emotions (for example, fear, uncertainty). Underline the words the students identify and have them describe the emotion implied. Ask them how they think such words influence their opinions about the facts when they read them. Ask them if pictures could also influence their opinion (for example, flags waving in the wind, children in war zones, pollution).

6. Discuss the difference between a news article (reports the facts), an editorial (strong point of view expressed), and an opinion piece (point of view is that of the author). Ask the students to classify each article.

7. Ask them to express their opinion about the situation: should James Blanchard have been convicted? Should he have been sentenced as he was? Why or why not? After several students have expressed their opinions, have the class identify any emotion-laden words they used.

8. Explain that people often express their emotions when they are expressing opinions about situations they care about. Ask them if they think facts, opinions, or a combination of both should be used to reach judgements and to make public decisions that affect the environment.

Reference

Ranger Rick s Naturescope. 1986. Wading into Wetlands. National Wildlife Federation.

Extensions

1. Discuss the significance of impacts to the environment. Ask the students: What did the judge consider in determining if a crime had been committed (the law itself and whether it had been violated) and the severity of the punishment (the attitude of the violator). What was considered in the editorial (purpose of the development project, political motivations of prosecutors, background of the violator, justification for wetland protection vs. needs for economic growth)? Discuss how the attitudes and values of society are expressed in different ways using the process of passing laws, enforcing laws, and expressions of a free press.

2. Have the students write editorials and factual news stories of their own about this situation or a situation of their choice. Encourage them to write the editorials as convincingly as possible, using emotion and value-laden words.

3. Ask the students to bring in examples of pictures or stories that rely on emotion or selective use of facts to convince others.

News Article

Court Delivers Harsh Wetlands Verdict

The U.S. Court of Appeals has denied a petition by James Blanchard to overturn his conviction for filling in part of a wetlands area that he wanted to develop. A three-judge panel affirmed without comment Friday the conviction and sentence of Mr. Blanchard to two years in jail and a fine of as much as $150,000.

Blanchard was convicted in a jury trial in November 1988 on 30 counts of violating the federal Clean Water Act after being accused of repeatedly ignoring warnings by federal officials and filling without a permit about 7 acres of a 25-acre tract he had bought in hopes of expanding his small storage business.

Federal prosecutors in the case alleged that Blanchard bought 25 acres of seasonal marsh land at a discounted price after the Corps of Engineers had classified it as a wetland. Blanchard then proceeded to fill in his parcel in order to build a storage business. Federal investigators video taped Blanchard's further violations of the Clean Water Act.

Blanchard's tug-of-war with federal environmental officials over the 25-acre tract made him a hero with the U.S.A. Future Society, a conservative think tank.

The group campaigned against what it portrayed as an attempt by aggressive federal prosecutors to use Blanchard as an easy case with which to set a precedent for imprisoning business executives for environmental offenses.

In July, Blanchard was sentenced to two years of imprisonment, fined $150,000 and ordered to restore the land when he gets out of prison.

Editorial

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With prompting from EPA officials, a court sentenced Blanchard to the maximum two years in jail and fined him more than $100,000. This is the longest jail term ever for environmental violations, including real polluters.

Mr. Blanchard's real crime in this case seems to be that neither he nor the engineers he consulted were immediately able to negotiate the regulatory labyrinth that allows you to put topsoil on your property. It takes a permit to do that on a wetland, depending on which regulations you read, whose advice you get and what your lucky number is. U.S.A. Future Society lawyers representing Mr. Blanchard, who had no prior criminal record, say he didn't need a permit. But EPA agents, who secretly filmed trucks bringing the contraband topsoil to the property, say he did need a permit. Several of them, in fact.

Wetlands priorities may be nice to talk about, but in practice is it right to be harassing small businessmen?

Opinion Column

Mr. Blanchard Mired In Wetland Stand

Martin Pundit, Syndicated Columnist

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To the Guardian, Blanchard innocently discovered "how little regard the Environmental Protection Agency has for a man's right to own property." The Guardian's story drew a picture of Blanchard as a virtuous immigrant who sought to improve an illegal dump next to his home.

Poppycock! The Guardian's moral outrage should be focused on a better cause. The only flabbergasting aspect of this case can be found in the defendant's flabbergasting contempt for the law. Back in September 1986, when the story begins, Blanchard was operating a storage business. He wanted to expand by purchasing an adjoining 25-acre tract. Elton Houser, the real estate broker representing the owner, gave Blanchard the first of a dozen warnings he would receive: it was a "wetland" that could not be developed.

Blanchard consulted three engineering firms. They confirmed Houser's opinion: The tract was indeed a wetland. They told him he could not fill it without getting a permit. Blanchard paid no attention. He began to deposit fill, even though he did not own the land.

In May, 1987, Aldus Oleander, an inspector for the Corps of Engineers, learned of the fill operation. He examined the site and found typical wetlands vegetation. Soil borings and hydrological tests were positive. Oleander advised Blanchard that he could not continue to fill without permission. On June 10, Blanchard bought the property at a reduced price (because of the wetlands determination). Oleander came back and saw that additional fill had been deposited. After Blanchard continued to ignore repeated warnings, the Corps of Engineers issued a formal cease and desist order. Blanchard ignored the order. On November 12, the Corps filed a notice of violation. Blanchard ignored this notice also.

The violations continued, and meanwhile adjoining properties began to suffer from flooding. The natural drainage into the nearby canal had been disturbed.

Through the use of video equipment 28 violations of the order were documented over the next two weeks. The evidence against him was overwhelming. Blanchard went on trial before a jury.

So much for the Guardian's poor flabbergasted Mr. Blanchard. This correspondent knows enough of bureaucracy to know that bureaucrats sometimes abuse their power. But protection of our remaining wetlands is absolutely vital to the national ecology, and in this case there was no abuse. Blanchard went looking for trouble. He got what he asked for.

WHO DOES WHAT? -WETLANDS

Objectives

Students will learn:
1. Which natural resource agencies are involved in wetlands regulation.

2. Whether organizations are federal or state agencies.

3. The function of each organization.

4. The role of the public in wetlands decisions.

Method

Students will play a card game to learn the functions of various organizations which participate in management decisions affecting wetlands.

Background

A confusing array of governmental agencies participate in management decisions affecting wetlands and wildlife that depend upon them. Many have distinctive emblems and uniforms. Few people recognize the uniforms employees wear and which organization it represents. It can be difficult to learn and remember which groups have responsibilities for which wildlife management activities. This activity is designed to alleviate some of this confusion and give students an opportunity to learn to recognize emblems and to clarify the functions of several groups which are active in wetlands management. The public also has an important role to play in decisions affecting wildlife habitat.

Materials

- Natural Resource Group Cards

Procedure

1. Begin by asking the class questions which relate to the function and jurisdiction of federal and state agencies that deal with wildlife. If possible, invite guest speakers to talk to the school about their jobs.

Subjects: social studies, careers
Skills: identification, comparing similarities and differences
Duration: one class session
Group Size: small groups
Setting: classroom
Vocabulary: impacts, regulation, management

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2. Give the Natural Resource Group Cards to the students. Some students will have cards with emblems and some will have cards with descriptions. Then ask students to find their "buddy" — the person whose card pairs with theirs. (Option: ask "buddies" to role play their organization for the students in the class.)

3. Use the organization cards to play a "Go Fish" game in groups of four or less. Pass out cards until each player has four cards. Place the remaining cards face down in a pile in the center of the players. The object is for the players to match the name card with the card listing its function. Each turn a player can ask one other player if he/she has the card that matches one of their cards. If so, that player forfeits the card and the first player lays down the pair on the table and can ask again for another match.

If no match is made, the player is told to "Go Fish", and draws a card from the pile. The player must wait until his/her next turn to put the card down if a match is made with the card drawn from the pile. The player to put all cards down first wins, or the game may continue until all the cards are matched.

Variation

On a table, lay all the cards face down. This game is like "Concentration." A student chooses two cards. If one card is the organization name and the other is its correct function, the student keeps the cards. If not, the cards are returned to their exact position on the table. Then another student tries to remember where the correct cards are. The game is over when all the cards are gone. The student with the most cards at the end of the game wins.

Evaluation

Hold up each card and ask students to correctly name the function and jurisdiction of each agency.

Extensions

1. Invite representatives from one or more of the agencies to your classroom. Brainstorm questions to ask the visitors based on the function of the agency.

2. Invite other speakers who participate in the wetlands permit process as members of the public (for example, representatives of conservation groups, representatives of industry groups) or individuals who regularly apply for permits (for example engineering firms, local governments, construction contractors). Ask them to describe the process from their viewpoint.

Natural Resource Group Cards

ALASKA DEPARTMENT OF FISH & GAME (ADFG)

Responsibilities:
- Protects, maintains, and improves the fish and wildlife resources of the state of Alaska. Primary management responsibilities are over fish and resident wildlife (species that live all their lives in Alaska) with the exception of marine mammals.

- Reviews development projects proposed in wetlands that require permits from the U.S. Army Corps of Engineers for impacts on fish and wildlife.

- Provides information on the importance of the wetland as fish and wildlife habitat.

- Recommends steps the developer can take to cause as little harm as possible to fish and wildlife or to their habitat.

- Manages several areas of the state which have been set aside as Alaska State Refuges, Sanctuaries, and Critical Habitat Areas to protect important wetland habitats.

ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION (ADEC)

The state agency with responsibility for air and water quality.

Responsibilities:
- Reviews development projects proposed in wetlands for their effects on water quality.

- Compares the potential for different types of pollution products against legal limits that can be allowed.

- Works with industry to develop technologies that reduce or eliminate pollution.

- Enforces laws to protect water quality.

- Oversees the clean-up of spills or illegal discharges of pollutants such as oil.

ALASKA DEPARTMENT OF NATURAL RESOURCES (ADNR)

The state land-management agency.

Responsibilities:
- Inventories and assesses state lands, including wetlands.

- Formulates land use plans for state lands.
- Administers permits and leases for all state-owned lands which includes all tidal and submerged lands within 3 miles of state-owned lands.

- Issues all water rights permits.

- Manages sales and releases of oil and gas and minerals on state lands.

U.S. DEPARTMENT OF INTERIOR/U.S. FISH AND WILDLIFE SERVICE (USDI/USFWS)

The federal agency that manages fish and wildlife, and the primary manager of migratory birds.

Responsibilities:

- Reviews development projects proposed in wetlands that require permits from the Army Corps of Engineers primarily for impacts to migratory birds, fish, and endangered species.
- Reviews federal water projects such as proposed dams and projects that require Environmental Impact Statements to determine the project's effects on wetlands and wildlife.
- Conducts research and provide information on the habitat values of wetlands.
- Recommends ways the impacts on wetlands and wildlife can be reduced or avoided.
- Evaluates the importance of specific areas as fish and wildlife habitat.
- Produce wetland maps.
- Land manager in Alaska, managing 16 federal wildlife refuges in Alaska.

NATIONAL MARINE FISHERIES SERVICE (NMFS)

The federal agency concerned with management, research, and services for protection and use of living marine resources.

Responsibilities:

- Reviews development projects proposed in wetlands that require permits from the Army Corps of Engineers; determines impacts to fish and shellfish species such as salmon or crab that are harvested commercially and endangered marine mammal species under their jurisdiction.
- Provides information on the importance of the wetland as fish habitat.
- Recommends steps the developer can take to cause as little harm as possible to fish or to their habitat.
- Conducts research on the effects of different types of development on the fish and fish habitat.

U.S. ARMY CORPS OF ENGINEERS (COE)

A permit is required from this federal agency for any construction activities that require dredging (ditching) or fill (depositing gravel or other materials) in wetlands.

Responsibilities:

- Distributes permit application to state and federal agencies and performs public reviews to evaluate the probable environmental impacts to the public.
- In making a decision whether the activity should be permitted, the Corps weighs the benefits of the project (for example, jobs or economic benefits) against the damages to the environment (including fish and wildlife habitat, water quality, and other wetland values) that might occur.
- Decides if the project is "in the public interest."

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Responsibilities:

- Controls discharges of pollutants into wetlands and other water bodies and regulates spill of oil and other hazardous substances.
- Applies guidelines to ensure the requirements of the Clean Water Act to protect wetlands are met. The EPA can deny or restrict discharges which may have an unacceptable, negative effect on wetlands.

FEDERAL LAND MANAGERS

The Bureau of Land Management (BLM), National Park Service (NPS), and the U.S. Forest Service (USFS) manage federal lands. Both BLM and the USFS allow development on their lands under a policy of multiple use. Development projects that will have impacts

PUTTING IT ALL TOGETHER

Objective

Students will identify and research issues related to wetlands management for wildlife and participate in decision-making about land uses.

Method

Students will go through a problem-solving process using a local issue.

Background

The outline of activities which follows is adapted from an Alaska Science and Society module that will be incorporated into the Model Science Curriculum Guide being developed by the Alaska Department of Education. The activities provide examples relevant to wetlands issues. The approach is also similar to the problem-solving approach used in Science, Technology and Society units and the Future Problem-Solving Program.

Dealing with issues is an excellent way to guide students in thinking for themselves and in learning how to be an effective citizen in a democratic society. However, the fact that an issue exists implies controversy. Local issues can be particularly "hot," and can deeply divide and polarize a community. As you plan classroom activities, be sure to consider how to present the issue in a balanced, factual way.

Wetland issues usually arise in Alaska communities when development is proposed on a particular wetland or when land use planning affecting wetlands occurs. When development is proposed, the public decision-making process is triggered by an Army Corps of Engineers permit application and public notice. In

the event of land use planning by local, state, or federal agencies, a series of comment periods and public meetings accompany the planning process. If you wish your students to get involved in decision-making, these are the processes they can model in the classroom through role-playing. They can also participate in a current local issue by writing letters or testifying at public meetings.

The same outline of activities can be followed for more general wetland issues. Examples include development of a national "no net loss" wetlands policy and how it might or might not be applied to Alaska (See the Teacher Information Manual, Part I, "Humans and Wetlands" for background information), expanded agriculture in California wetland wintering areas for many birds which nest in Alaska, and expanded agriculture in the "prairie potholes" area.

Procedure

I. ISSUE IDENTIFICATION

1. Identify an issue of local importance and student interest

Read newspapers.
Observe local media.
Brainstorm.

Consult local agencies or government officials about any upcoming public wetland permits or planning decisions.

2. Select the issue

Establish the availability of information through community interviews or by writing appropriate agencies or organizations (see Resources section for names and addresses).

Develop criteria and select the appropriate topic, stated as a question. As examples: should this wetland be developed or protected as wildlife habitat? What is the best way to accomplish the proposed development project and maximize protection of public wetland values?

3. Dissect the issue into components

Brainstorm.
Examples:
- For the development project: Are roads required to get to the site? At what cost? Who will pay? Will roads, construction, etc. disrupt the community or the environment? Economics: How many jobs will the development provide? Will these go to local people?

- The fish and wildlife habitat: Will the wetland be filled? How much of it? Will areas downstream of the fill be polluted? Will construction take place during a sensitive period such as when birds are nesting? Will fish be able to migrate up and downstream? Will the drainage pattern be changed?

- Other wetland values: Will flood storage be reduced? Will pollution be increased? Will increased pollution affect humans, fish, or wildlife? How will they be affected?

4. Determine the information needed

Brainstorm data needs for each component of the issue (for example, fish and wildlife use patterns and important habitat areas, construction methods of the project, types of discharges into a wetland that will occur and their toxicity).

II. RESEARCH

1. Research the decision-making framework

Learn and use the various ways citizens can become informed and effect the solution of the chosen issues. Research information sources including people who use the wetland: experts, library, media, laws, observations, newspaper articles, and agency reports.

Research regulations and laws related to wetland protection (for example, Clean Water Act, Army Corps of Engineers regulations, National Environmental Policy Act, private property rights).

Research regulations and laws that allow the public access to information (for example, Freedom of Information Act, COE Public Notice requirements).

Construct a timeline that illustrates when or where decision-makers will be seeking public input on a chosen issue. For example, review the Army Corps of Engineers permit and appeal timeline.

Review the history of similar issues and analyze the success or failure of past strategies by members of the public to influence the decision. Request advice from individuals, representatives of groups, or government agencies that participate regularly in the decision-making process.

Identify the specific institutions and regulations

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related to the chosen issue (See the Teacher Information Manual, Part I).

Prepare a flow chart listing the players and effective methods to contact them.

2. Practice scientific processes

Formulate hypotheses about the issue and confirm with existing data or by duplicating the research.

Evaluate attitudes using scientific standards of fact.

Evaluate objectivity of sources of information.

Distinguish between facts and opinions.

Conduct your own evaluation of the site (see Rate a Wetland in the Field Manual).

Conduct interviews about values and uses by people in the community and analyze the data.

Simulate the effect of the project on wetland plants (for example, cover them with gravel, cut off water flow) and observe the effects.

3. Define the social implications of the issue and various solutions

List the variety of types of people in your community who are affected by the decision and consider the impact on each different type (for example, Native elders, subsistence family members, the business community, unemployed heads of household, school children, etc.).

4. Relate the impact of technologies to the issues

Identify technologies that influence different problems in the issue (for example, construction vehicles with different types of impacts on wetlands, drainage structures through fills such as bridges or culverts, pilings vs. fill as support for buildings).

Consult experts and evaluate whether there is a technological solution to the issue (for example, redesign a development project or change an operation that would lessen impacts on fish and wildlife and their habitats).

III. DECISION-MAKING

1. Determine possible solutions, using scientific and social data. Test the validity of arguments.

Brainstorm.

Explore emotions and values in relation to the data and issue.

2. Select and implement a solution

Make individual choices or solutions.

Prepare an individual action plan.

Communicate solution/plan to others.

Collaborate with others to implement a joint solution through speaking at public hearings, writing letters to decision-makers, working with parents and civic groups, and using local media to influence public opinion on the issue.

IV. EVALUATION

1. Evaluate the public decision-making process

Discuss: How accessible was it? Did it respond to scientific and social reasons and values? What was the quality of the process?

2. Communicate judgments

Share with other teams.

Write to officials and the media, supporting their decisions, appealing decisions, or recommending changes in the process.

3. Generalize conclusions to other situations

Discuss: Under what conditions do you think development should be accompanied by actions to avoid or reduce damage to wetlands? Are there conditions under which impacts to wetlands may occur and such actions are inappropriate (for example, emergencies where human life is threatened, war, lack of alternatives for a project that fills a community need such as health care, etc.)?

Resources for Wetlands Issues

Alaska Public Affairs Journal, Summer, 1990 issue contains articles representing the viewpoints of the Army Corps of Engineers, a wetlands ecologist, an oil company representative, and a logging company representative on wetland regulatory issues in Alaska.

CLASS PROJECT "Wetlands in Alaska" unit. 1986. Includes the activity "Developing a Wetland: a Conflict of Values," a role-play about a wetlands issue. Available from the Wildlife Federation of Alaska, 750 W 2nd Avenue - Suite 200, Anchorage, AK 99501.

Groups likely to have a position on Alaska wetlands issues:
Landowners: Native Corporations, state and federal landowners
Oil companies
Industry groups: Alaska Forest Association, American Oil and Gas Association, etc.
Conservation organizations: The Wildlife Society, Alaska Chapter of Wilderness Society, Ducks Unlimited
Municipality or Borough governments (contact planning departments)

Adopting a Wetland: a Northwest Guide. 1990. Adopting a Stream: a Northwest Handbook. 1988. University of Washington Press. These two books provide practical information about gathering information about streams and wetlands and taking action to improve them or protect them.

America's Wetlands: our vital link between land and water. 1988. U.S. Environmental Protection Agency. EPA-87-016. Describes wetland functions, EPA involvement in wetland resources, and regulatory measures. Available from EPA Public Information Center, 401 M Street SW, Washington, D.C. 20460.

Our Nation's Wetlands. 1978. Summarizes wetland functions, the impacts of different types of land use on wetlands, and laws regulating wetlands. Excellent diagrams illustrate the concepts. U.S. Government Printing Office 0-329-527.

A Citizen's Guide to Protecting Wetlands. 1989. The National Wildlife Federation. Provides a step-by-step guide to the Clean Water Act 404 permit process for the layman. Available from NWF, 1400 16th St., N.W., Washington, D.C. 20036-2266.

Development in Alaska's Wetlands and You: the Corps of Engineers and You. Available from the Army Corps of Engineers (800-478-2712). Sample permit applications also available.

Protecting America's Wetlands: an Action Agenda. Final report of the National Wetlands Policy Forum. 1989. The Conservation Foundation. A review of issues related to wetland management in the U.S. and specific changes in laws and programs needed to protect wetlands. Available from The Conservation Foundation, 1250 24th St., N.W., Washington, D.C. 20037. Send $2.00 for shipping.

Wetlands: Meeting the President's Challenge. 1990. A wetlands Action Plan for the U.S. Fish and Wildlife Service. Includes a discussion of the application of a no net loss policy to Alaska's North Slope wetlands. Available from U.S. Fish and Wildlife Service - Habitat Enhancement Division, 1011 East Tudor Road, Anchorage, AK 99503.

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CAN DO!
- WETLANDS

Objectives

Students will:

1. Identify a problem involving wildlife on their own school grounds, in their village, or nearby.

2. Suggest and evaluate alternative means to either solve the problem or improve the situation.

3. Undertake the project to solve the problem.

4. Analyze and describe the process by which they successfully solved the problem or improved the situation.

Method

Students select a school environmental project, conduct research, make plans, and follow procedures to accomplish the project.

Background

This activity is designed for students to identify a local situation in which they can improve and help wildlife. The situation can either involve actual "hands-on" experience, like litter pick-up or planting, or it may involve a political action project in which the students learn how to influence people in authority to carry out a desirable action for wildlife. The activity "Putting It All Together" focuses on the problem-solving and decision-making process.

Each of us can make constructive contributions to improving the environment in which we live. Sometimes our actions can improve the environment for people, sometimes for wildlife, and sometimes for both. Sometimes our effectiveness can be improved if we work with other people sharing ideas, information, and skills. A working knowledge of the following terms will be useful to students in this activity:

Problem: a difficult situation to be improved, or an opportunity to make things better. Problems can

Subjects: social studies, language arts, science
Skills: analysis, discussion, evaluation, problem solving
Duration: three class sessions
Vocabulary: problem, authority, compromise, alternatives
Topics: responsible human actions, people and wildlife sharing environments

not always be "solved," but situations can usually be improved.

Authority: an individual or group of people with the power to make changes.

Compromise: a way to settle a problem in which both "sides" usually give a little.

Given that it is important for young people to learn that they "can do" for people, wildlife, and the environment, use your judgement in the course of this activity to assist students in selecting a project that is realistic, constructive, and possible. If not, the students may experience an activity that contributes to their thinking that they "can't do." The major purpose of this activity is to provide students an opportunity to experience success in taking constructive actions to improve the environment for people and wildlife.

Materials

- writing materials

Procedure

1. Ask the students to think of some ways to improve local areas as homes for wildlife. They might generate a list of activities on their school grounds or in their community that have a negative impact on wildlife. The list might include: litter that poses a hazard for some kinds of wildlife, a proposed pesticide spraying that will not only kill the "pest" but perhaps affect other plants and animals, removal of plants that presently help contribute to cleaning the air, producing oxygen, and serving as food and cover sources for varying kinds of wildlife, etc.

2. Look at the list of possible wildlife habitat problems and the suggestions for ways to improve wildlife habitat at school. Ask the students to select one they think could realistically handle and do something constructive about. If they have difficulty deciding, and reasonable support has been offered for each, the students might vote to decide. Students could also make speeches in support of the problem they want to tackle, in hopes of swaying the class vote.

3. Once the problem has been selected, ask the students to work alone or in small groups to begin to generate ideas for possible solutions to the problem and ways to implement the project. Each individual or small group could come up with a plan, including written descriptions and sketches illustrating how to accomplish the project, step by step.

4. Ask the groups to present their plans to the rest of the students. Students may ask questions of the students. Once all the plans have been presented, ask the students to select the plan that seems most: a) constructive; b) realistic; c) helpful to wildlife; d) probable to make a lasting contribution.

5. Ask the students to select one or more alternative plans, in case their first choice is not acceptable to authorities at the school or village.

6. Once a plan (with alternatives for "back-up") has been selected, ask the students to select a delegation to present their proposal to the school principal or the appropriate authority. Remember to include janitors, grounds keepers, school board, etc. (anyone who would be physically and/or officially involved). A practice session before the students and any interested parents or other groups of students would be helpful. At the practice session, the student delegation would make their presentation as they plan to do before the principal, (janitor, council, etc.) responding to any questions from their audience that might be raised.

7. The students should make an appointment to present their proposal, make the presentation, and report back to their classmates. If their plan is accepted, they should make sure they know who to contact next in order to successfully complete their project. Making sure they have all necessary permissions secured, the students should proceed to successfully accomplish their project.

8. Once accomplished, ask the students to analyze their results. Did things work out the way the students wanted them to? Were there any surprises? Any unforseen problems? How might they have been any more effective?

Can do list for possible community projects:

- create a wetlands plan for the area around your school: map wetlands, evaluate their functions using the Rate a Wetland activity in the Field Manual, map surrounding land uses, determine which wetlands should be conserved, compare this with actual community wetlands plans.

- initiate a water quality testing program for a stream or wetland near your school; problem-solve reducing pollution. (For information about how to set up a

monitoring program, obtain the publication Adopting a Stream.)

- initiate a recycling program in your school to reduce the demand for mineral resources found in wildlife habitat.

- develop an anti-littering campaign or clean-up day for local streams or wetlands.

- adopt a stream or wetland - obtain the publications Adopting a Stream or Adopting a Wetland for ideas. Contact Jon Lyman (Alaska Department of Fish and Game, Sport Fish Division, Box 240020, Juneau, Alaska, 99824) for a detailed activity guide about a stream sampling program for your school.

- grants may be available for local civic groups, government organizations, or sport fishing organizations to help you with a fish stream improvement project. Contact a local sport fish office for more details.

- develop an information program for the community about your wetland and any problems facing it: leaflets, posters, videotapes, newspaper articles, displays at local events.

- develop a wildlife calendar for a local wetland, interview people in the community, or make observations to find out when the different species of migratory birds return and leave, when they nest, when the water freezes over, etc.

- produce a classroom newspaper with articles about wetland habitats and wildlife.

- research water use in your community. (Where does it come from? Where does it go? How is it used? Are things added to it or to sewage before discharging it back into water? Where is pollution occurring?) Have students make personal and household inventories of water use and brainstorm ways to reduce use and pollution.

- undertake a project to improve a stream for fish or a pond for waterfowl. (Contact the Alaska Department of Fish and Game or U.S.D.A. Forest Service for help.)

- survey the community about the abundance of wildlife in local wetland areas, and their use of the wildlife. Be sure to include older people and Native elders to determine how the areas and use has changed over their lifetime.

Reference

Project WILD. 1986. "The Monday Group, from Awareness to Action." Western Regional Environmental Education Council.

Extension

Document the entire process on video tape.

Unit 5 — Migratory Birds and Wetlands

Page

Migratory Mapping 107
Students learn the migration route of common migratory birds. This is done by compiling and mapping data from actual bird reports, bird sightings, and recoveries.

Sampling Populations 124
Students discover the difficulties of sampling populations by playing a simulation game.

Fowl Play 127
Students develop their analyzing and problem-solving skills by playing a game in which they employ wildlife survey techniques to determine the cause of a drop in a waterfowl population.

The Brant Game 134
Students play a board game that simulates bird migration and the effects decisions about wildlife use and habitat development may have on the migrating bird population.

Birds Now or Later 148
Participants make decisions about how many pennies or crackers (representing birds or bird eggs) they take from a common source. By adjusting their "take" each turn, the students find the highest number they can take each time and still increase the total number of pennies.

Where Do You Draw The Line? — Migratory Birds 150
Students listen to a statement, decide their opinion about it, then place themselves on a line according to their opinion.

Who Does What? — Migratory Birds 154
Students play a card game to learn the functions of various organizations which participate in management decisions affecting wildlife.

Can Do! — Migratory Birds 159
Students select a school environmental project, conduct research, make plans, and follow procedures to accomplish the project.

Stamps For Birds 162
Students design and create a Duck Stamp and wetlands conservation message.

MIGRATORY MAPPING

Objectives

Students will :

1. Map the migration route of geese based on band and neck collar recovery reports.

2. Define the terms "wintering grounds" and "breeding grounds."

3. List two uses of band reports.

4. List the four major flyways in North America.

Method

Students analyze information from band and neck collar recovery reports. With this data they chart the four major North American flyways.

Background

Banding is done to provide information regarding migratory birds' routes. Through recovery of bird bands, data on direction and duration of migration is obtained. Sightings of live tagged birds and retrival of dead bird tags provide additional information about bird use of migration areas.

The U.S. Fish and Wildlife Service Bird Banding Laboratory in Laurel, Maryland maintains a record of all bird bands in the United States. All researchers must obtain permits from the Bird Banding Laboratory in order to embark on a bird marking project. Marked birds must have, at a minimum, a silver colored U.S. Fish and Wildlife band with an 8 or 9 digit number. This number and all information about the bird—such as sex, age, weight, condition, date, and place of banding—are on file at the Bird Banding Laboratory.

Quite often researchers will also tag another part of a bird. This extra tag is usually colored and has a combination of letters and numbers that identify that bird in the biologists' study. Some of the colored tags have larger, more distinct codes that may be read from a distance. If a biologist wants a goose to be distinct, he or she may add a colored neck collar with a code such as "8Y3" in large print.

Subjects: science, social studies.
Skills: mapping, interpreting data.
Duration: two class sessions
Group Size: whole class, then small groups
Setting: indoors
Vocabulary: migration, banding, flyway, wintering and breeding grounds
Topics: migration, geography, bird banding, career education, people and wildlife sharing environments

If you find a banded bird and can read any or all of the numbers on the bands or the neck collar, you should contact the U.S. Fish and Wildlife Service and they will forward the information to the Bird Banding Laboratory. The laboratory staff will look up the numbers and contact the biologists who initiated the study. The biologists will then use the information that you gave them about the circumstances in which you saw the bird in their studies. The laboratory will also let you know when and where the bird was banded.

Geese migrate in a Vee or cluster formation at about 50 mph. Their movement is steady and unhurried and closely follows the movements of the seasons. Geese migrate along all four flyways. They make their spring migration (south to north) from February to April. Fall migrations (north to south) occur from September to December. Some birds use only the Pacific Flyway while others, like tundra swans, cross or use all four North American Flyways. **Flyways** are generalized migration pathways. Although species' actual migrations do not strictly conform with these flyways, they are a useful way of generalizing migration routes. Band recoveries help to indicate which flyways birds use when migrating. From bird band returns biologists have discovered that during spring migration birds make more stopovers as they follow improving weather northward. In fall the birds wait and move south all at once to good weather.

Materials

- masters provided: Goose Reports, map of North America, maps of four North American flyways, real computer-plotted band reports
- large classroom map of North America or overhead projection of blank map of North America
- contact paper "dots" or push pins
- string or thread
- colored pencils

Optional: National Geographic produces a map that is excellent for this activity if students plot their data on mylar overlays. copies of the 21" X 28" "Map of North America" can be obtained from National Geographic Society, Washington, D.C. 20036.

Procedure

1. The Goose Reports contain 62 band reports. These reports are simplified versions of real data that have been turned in to the U.S. Fish and Wildlife Service. There are two ways to do this activity:

a. **Younger students:** While students follow along on their own maps, plot the band reports on a large map at the front of the classroom. See the following procedures for more detailed instructions. Before beginning the activity, copy the band reports using a different color paper for each flyway. Cut into strips. Place the band reports into a box or a hat.

b. **Older students:** Have students break into groups and either plot a single flyway or plot all 4 major flyways to compare with other groups. Make as many copies of each set of band reports as you'll need for the groups.

2. Have the students read the article "Goose Round-up at Old Chevak Corral" in the Alaska Fish and Game magazine. Explore the topic of migration. Why do birds come to Alaska to nest? (To take advantage of vast food sources and large areas for nesting.) Why do they spend all that energy migrating south? (Warmer wintering grounds provide sufficient food.) How do biologists find out where all the birds in Alaska go and where they stop along the way?

3. Introduce students to the idea of **flyways**, which are generalized north-south migratory corridors. Although species' actual migrations do not strictly conform with these flyways, they are a useful way of generalizing migration routes.

Recoveries of bands from birds can help to indicate along which flyways birds migrate. Use the large map of North America or an overhead projection and ask students to guess where geese go in the winter and which routes they take.

4. Hand out copies of the North American maps to each student. Each map should have all of the states and Canadian Provinces (including the Northwest Territory islands).

Help students speculate which routes geese might take as they move south from Alaska. Formulate a **hypothetical** flyway map based on these speculations.

5. Tell students that they are wildlife biologists compiling recovery data. The Goose Reports are band numbers and neck collar observations that people have given to wildlife biologists so that they can track where the geese have been. Each report gives the following information:

a. A band number (explain to students that actual band numbers would be longer. See "Background" for more information).

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b. Where the goose band and/or neck collar was found or seen.

c. Where the goose was banded (In "File Data"). Occasionally, someone will report seeing a band or neck collar more than once.

It is the students' job to mark these data on the map.

6. As an example, take one of the Goose Reports from the hat or box. Have a student read about where the goose band was found. Have the class help you find the area where the bird was found and pinpoint it (with contact paper dots or push pins) on your map at the front of the class. (An overhead projection of the blank North America map works just as well.)

Have students follow along and make a circle on their maps and fill in the band number. Then have a student read the "File Data" from the Goose Report. Find the area where the goose was banded and mark that area with the same band number. Stretch a string or a thread between the two points on the large map in front of the class. Have students draw a straight line between the two points on their maps. (If possible, use the same color as the Goose Reports.)

a. **Designating the four species of geese:** Students may make a key for the different species of geese. For example, a brant may be designated by a triangle and Canada geese by circles, etc.

b. **Fall vs. Winter Migration:** While bands are recovered year-round, the information students receive will be mainly from late summer and fall migration periods. (Have students suggest why more bands might be recovered at these times of the year). Students can tell the difference by the dates: spring migrations generally occur between February and April and fall migrations between September and December. Reports from January, May June, July and August indicate non-migrating times of the year. During summer months geese are at their breeding grounds; during January they are wintering in more southern areas.

Students can use different colors for migration dates, and for dates indicating presence on wintering grounds. For example, reports turned in during the fall migration could be entered in brown pencil, winter reports in gray, summer banding in red, etc.

7. Pass the band reports around until each group has completed either a flyway and/or, all four flyways. As each point of information is read, mark the report on the map at the front of class and have each student mark their own maps. The result should be a set of straight lines that suggests a funnel leading from Canada, Alaska and the northern states to the central and southern states.

8. When one flyway is completed, have students compare their data. With crayons or colored pens, have them draw a western, southern, and eastern boundary to the flyway which suggests an arrow.

9. Continue plotting the other 3 flyways. Be sure to stop after the band reports from each flyway are completed and mark the boundaries of that flyway.

10. Pass out actual North American Flyway maps so that the students can compare their maps with the key. Have students label the 4 flyways. Their data will indicate that the geese used in the activity breed mostly in Alaska and Canada. They migrate along the Pacific Flyway, the Central Flyway, the Mississippi Flyway, and the Atlantic Flyway.

11. Take the opportunity to point out different circumstances of band recovery (accidents, hunters, etc.).

12. Show the students the Real Computer-Plotted Band Returns and compare them to their own maps.

13. Engage students in a discussion of the following questions and topics:

a. Where in Alaska have bird bands been recovered? Do band returns show that they are where you live? If not, do you know if geese migrate through your area? How do you know?

b. Where are geese banded and when? (*Geese are usually banded in their nesting areas while they're molting and can be easily captured.*)

c. Are there any areas where band recoveries are concentrated? What types of habitat would you find there?

d. Which flyways do geese in Alaska use?

e. Which birds were reported on spring migration (March- May), breeding season (June-August), fall migration (September-November), or wintering grounds (December-February)?

f. How old were your reported birds? Do most live long? Of all the reports, what percentage of birds survived more than one year?

g. What is the shortest time a bird took to get from a nesting area in Alaska or Canada to a wintering area in California, Louisiana, or North Carolina?

h. Do white-fronted geese from southern Alaska winter in different areas than those from northern Alaska?

i. Do Canada geese from Alaska winter east of the Rocky Mountains?

j. How many different ways are reports of banded birds obtained (*e.g., shot by hunters, seeing marked birds, finding dead birds, etc.*)?

14. Discuss what people can learn from band returns and information about bird migration. (For example, returns tell us where important feeding and resting areas are so that they can be protected, where and how many birds are taken by hunters so that the harvest can be regulated to maintain healthy populations, how much energy birds need, how long birds live, etc.)

Evaluation

Have students answer the following questions:

1. How might wildlife biologists estimate the size of: (*Several answers are possible for each. The most commonly used are given.*)

a. A flying flock of migrating birds? (*An estimate can be made by direct observation along the migration route.*)

b. Waterfowl populations? (*Aerial surveys of nesting areas.*)

c. A population of birds that live in a small area? (*An estimate of birds in a small area can be made using capture/recapture method.*)

2. Is the capture/recapture technique a good method to use for estimating populations of migrating birds? Explain your answer. (*No. This method has been used on Canada geese, but generally it works best when the animal whose numbers are being estimated spends most of their time in a relatively well-defined area.*)

3. Number these facts in the order in which they might occur.

(3) a. A wildlife manager traps 100 birds: 30 have been marked and 70 are unmarked.

(1) b. A wildlife manager wants to know how many birds are in a habitat.

(4) c. A wildlife manager determines there are about 333 birds in the habitat.

(2) d. A wildlife manager captures and marks 100 birds and releases them.

(5) e. A wildlife manager decides whether to permit hunting or change the bag limit.

4. The capture/recapture technique is the main method used by biologists to measure population size. True or False? (*False. It is important, but it is only one of several methods*).

5. List three types of information that biologists can get from band return data. (*Common types of information are: age of the animal; sex of the animal; species of the animal; location of the original banding; and location of band recovery.*)

6. List the four flyways in North America.

Reference

Issue Pac. "Hunting and Wildlife Management." U.S. Fish and Wildlife Service.

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Extensions

1. Through research and observations made throughout the school year, students can note the varying numbers, types, and varieties of birds in the area and determine which species migrate and which do not. They can then study one migratory species they have identified in the area and use maps and bird guides to examine where the species migrate. Research should include the route and timing of migration, obstacles encountered, and traditional habitats used during the migration.

2. If possible, have a Fish and Wildlife Service employee or local bird bander bring in samples of actual bird bands and/or mounted birds with bands to discuss banding in greater detail. Have the speaker tell students what they should do if they see a band on a bird (either alive or dead). (Send the band from a dead bird to the address on the band and tell where it was killed. You will receive a certificate with information about that bird. Report a colored collar to the U.S. Fish and Wildlife Service or the Alaska Department of Fish and Game.) Perhaps the students can obtain data about band recoveries from birds banded in your area and plot them on a map.

3. Students from other areas could write to the Chevak High School students for more information about their banding work. The Yukon Delta National Wildlife Refuge also has videotapes of this banding work.

GOOSE REPORTS
Migratory Mapping

Pacific Flyway

1. A banded brant was found dead on the shore of Puget Sound in western Washington state on April 29, 1984
FILE DATA: Banded July 11, 1963 near Hooper Bay on the west coast of Alaska when it was one year old
(**Hint**: This goose is a brant and doesn't fly in a straight line; brant fly only over the ocean).

2. A British Columbia hunter shot a banded brant near the border between Washington and Canada at Boundary Bay on March 2, 1988.
FILE DATA: Banded July 13, 1963 near Hooper Bay on the west coast of Alaska. (**Hint**: This goose is a brant and doesn't fly in a straight line; brant fly only over the ocean).

3, 4, & 5. Biologists trying to describe the wintering ground of dusky Canada geese look for geese with red neck collars. They find 2 in southwest Washington state, 16 near Portland in northwestern Oregon, 27 in western Oregon, and none in California during December, 1990.
FILE DATA: The Alaska Department of Fish and Game put 100 red collars on dusky Canada gees during July 1989 near Cordova, Alaska where all dusky Canada geese nest.

6 & 7. During December 1990, geese crowded into a newly flooded rice field near Sacramento in central California. Disease spread by a sick snow goose killed 150 geese including a banded white-fronted goose and a banded cackling Canada goose.
FILE DATA: The cackling Canada goose was banded July 23, 1989 at the mouth of the Kuskokwim River in southwestern Alaska. The white-fronted goose was banded just south of King Salmon on the Alaska Peninsula on August 6, 1988

8, 9, & 10. Whale-watchers in Baja California (Mexico) saw a flock of brant in Scammon's Lagoon in west central Baja on January 15, 1990. Three birds had yellow leg bands.
FILE DATA: Biologists put yellow leg bands on 300 brant near Hooper Bay on the west coast of Alaska in July, 1990. (**Hint**: This goose is a brant and doesn't fly in a straight line; brant fly only over the ocean).

11 & 12. A snow goose with a brown neck collar was seen at Kenai, Alaska on April 20, 1991. Its mate wore a red collar.
FILE DATA: These birds winter in Puget Sound in northwestern Washington state where brown collars were put on in December 1988. They nest in Siberia across the Bering Strait from the Seward Peninsula in Alaska where red collars were put on in July, 1990.

13. Commercial fishermen found a fresh Canada goose skeleton with a yellow neck collar on the beach near Pilot Point on the north side of the Alaska Peninsula in September 1990. It was found with many other bones where eagles like to perch.
FILE DATA: This was a cackling Canada goose banded July 27, 1986 near Hooper Bay in western Alaska. Students from the University of California reported seeing this yellow collar number on November 16, 1989 near Sacramento (central California).

14. A banded snow goose was shot by a hunter near Wrangell in southeast Alaska on October 14, 1990. It had an American band on its left leg and a Russian band on its right leg.
FILE DATA: The American band was put on near the northern border of California at Tule Lake in November 1, 1986. Still waiting for information about the Russian band but it is presumed to be from someplace in Siberia across the Bering Strait from the Seward Peninsula in Alaska.

15. A farmer on Queen Charlotte Island, British Columbia, sees 3 Canada geese with red neck collars land in his hay field on April 17, 1991.
FILE DATA: Collar numbers indicate that these birds were band near Cordova, Alaska in 1987. One was seen on March 26, 1990 in a Seattle park in northwestern Washington.

16. While hunting at Cold Bay on the Alaska Peninsula, a hunter from Anchorage shot a brant with a blue leg band on October 20, 1990.
FILE DATA: Blue bands were put on 50 brant on (Banks Island which is northwest of the mainland in Northwest Territories) on July 20, 1989. (**Hint**: This goose is a brant and doesn't fly in a straight line; brant fly only over the ocean).

17, 18, & 19. A biologist was checking all the hunter records at a state hunting area west of Portland in northwestern Oregon. On October 16, 1990 he noticed that three marked geese were shot: a large Canada goose with a red leg band, a small Canada goose with a yellow neck collar, and a medium-sized Canada goose with a metal leg band.
FILE DATA: The large goose was a dusky Canada goose that was banded August 2, 1986 near Cordova, Alaska (Prince William Sound). The small cackling Canada goose was banded near Hooper Bay in western Alaska on July 26, 1989. The medium-sized Taverner's Canada goose was banded at Cold Bay on the Alaska Peninsula on September 23, 1978.

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GOOSE REPORTS
Migratory Mapping

Central Flyway

20. A banded white-fronted goose was found dead by a hunter in central Oklahoma near Oklahoma City, October 16, 1990.
FILE DATA: Banded in north central Northwest Territories at Coronation Gulf on July 22, 1983.

21 & 22. A wildlife refuge manager reported that he collected bands from a snow goose and a white-fronted goose that were found in group of dead birds that died from disease outbreak in Southern Nebraska 12, 1991.
FILE DATA: The snow goose was banded on July 13, 1989 on Banks Island in northern Northwest Territories. The white-fronted goose was banded on December 26, 1990 near Houston, Texas, on the Gulf of Mexico.

23. A banded white-fronted goose was shot by a hunter in western Nebraska, November 11, 1990.
FILE DATA: Banded at Fort Yukon, Alaska July 20, 1988.

24. A hunter reported a banded white-fronted goose that was taken by his party in central North Dakota near Bismarck, October 12, 1990.
FILE DATA: Banded on the west side of Great Slave Lake in southern Northwest Territories on July 28, 1990.

25. A banded white-fronted goose was found sick in a field of moldy peanut plants on December 16, 1990 in the central part of the Texas panhandle.
FILE DATA: Banded on fall migration in central Saskatchewan on September 4, 1989.

26. A white-fronted goose with a red neck collar was shot by a hunter in Barrow, Alaska on September 3, 1990.
FILE DATA: Banded near Prudhoe Bay, Alaska on July 26, 1987. This bird was seen near Houston, Texas on the Gulf of Mexico during the winter of 1988.

27. A banded snow goose was spotted by bird watchers near Corpus Christi in southern Texas on January 12, 1990.
FILE DATA: Banded at Banks Island in northwest Northwestern Territories on July 23, 1990.

28. A rancher in northeast Montana saw a coyote catch a banded snow goose and chased the coyote off his kill, September 25, 1990.
FILE DATA: Banded at Banks Island in northwest Northwestern Territories on July 23, 1990.

29. A banded Canada goose was killed by a hunter near Pierre in central South Dakota on November 23, 1990.
FILE DATA: Banded on the west side of Great Slave Lake in southern Northwest Territories on July 28, 1978. Recaptured at Edmonton in central Alberta on August 30, 1986.

30. A banded Canada goose hit a radio station antenna at night near Dallas in central Texas, October 29, 1990.
FILE DATA: Banded in northwest Nebraska on July 15, 1990.

31. The neck collar number of a Canada goose was read from a distance by an observer in west Texas on March 9, 1991.
FILE DATA: Banded on August 1, 1989 in central Wyoming.

32. A banded Canada goose was caught after being forced down by a tornado in western Oklahoma on September 15, 1990.
FILE DATA: Banded in western South Dakota on July 20, 1981.

33. A Canada goose band was sent from northeast Colorado with no information about cause of death September 24, 1990.
FILE DATA: Banded July 26, 1988 east of Great Bear Lake in central Northwest Territories.

34. A hunter reported a banded Canada goose in western Kansas on November 12, 1990.
FILE DATA: Banded on the north slope at the Yukon and Alaska border on August 2, 1990.

GOOSE REPORTS
Migratory Mapping

Mississippi Flyway

35. A banded Canada goose was killed in a hailstorm in northwest Missouri near Kansas City on September 11, 1990.
FILE DATA: Banded at Lake Winnipeg in central Manitoba July 15, 1990

36. A hunter reported that a banded Canada goose was taken by his party in central Iowa October 13, 1990.
FILE DATA: Banded at Lake Winnipeg in central Manitoba on July 15, 1990

37. A Canada goose was trapped in a fenced yard August 8, 1990, almost a year later near the same place where it was banded in northeastern Wisconsin.
FILE DATA: Banded near Green Bay, northeastern Wisconsin on August 16, 1989 as part of a flock that stays in the city park all year long.

38. A snow goose was banded in northeastern Manitoba and shot three months later on November 8, 1990 in southern Louisiana, near Lafayette.
FILE DATA: Banded in northeastern Manitoba, near Churchill on August 8, 1990.

39. A giant Canada goose was accidently killed when it was recaptured in a banding trap near Moorhead in northwestern Minnesota on July 26, 1990.
FILE DATA: Banded at Moorhead Minnesota, July 11, 1990.40. A Canada goose band was sent in from southwestern Ontario with no information about the band recovery or the cause of death of the goose, August 4, 1990.
FILE DATA: Banded in northeastern Manitoba, near Churchill on July 12, 1990.

41. A Canada goose was identified by its neck collar and reported from Eau Claire in western Wisconsin, September 19, 1990.
FILE DATA: Banded in central Iowa, July 16, 1987

42. A banded Canada goose was accidently caught by a fur trapper near southwestern, Manitoba on October 10, 1990.
FILE DATA: Banded on December 16, 1989 in southeast Minnesota near Minneapolis

43. A Canada goose was caught in central Illinois after being hit by car, November 29, 1990.
FILE DATA: Banded on July 6, 1990 near James Bay in northeastern Ontario.

44. A Canada goose was shot in Aberdeen, South Dakota, October 20, 1990, was almost 17 years after it was banded.
FILE DATA: Banded on January 6, 1974 in northwestern Arkansas near Fayetteville

45. Men at remote mining camp near Dubawnt Lake in southeastern Northwest Territories saw white-fronted geese moving north on April 26, 1990. One goose had a neck collar.
FILE DATA: Banded and marked July 17, 1988 on the north central coast of Northwest Territories.

46. A banded snow goose that was sick from lead poisoning was found in northeastern Iowa at Dubuque on October 23, 1990.
FILE DATA: Banded on Southampton Island in eastern Northwest Territories on July 3, 1984.

47. An Eskimo hunter on King William Island in northeastern Northwest Territories reported that he shot a white-fronted goose with a collar on May 20, 1990.
FILE DATA: Banded December 14, 1988 in a rice field in southern Louisiana near Baton Rouge in a rice field

48. On February 8, 1991, a banded snow goose was taken from 3 men in southwestern Louisiana, when a game warden arrested them for illegal hunting
FILE DATA: Banded at Cambridge Bay in southeastern Victoria Island, Northwest Territories on July 3, 1989.

49. A banded Canada goose was found entangled in a fish net near Traverse City on the northwestern shore of the lower peninsula of Michigan, April 5, 1990.
FILE DATA: Banded July 20, 1989 at James Bay in northeastern Ontario.

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GOOSE REPORTS
Migratory Mapping

Atlantic Flyway

50. A banded Canada goose was caught by hand near Bangor, Maine, August 18, 1990. The goose was molting and the flight feathers were not yet grown.
FILE DATA: Banded August 12, 1989 in southcentral Maine near Augusta.

51. A banded snow goose was found dead by a hunter in southcentral Maine on October 16, 1990.
FILE DATA: Banded July 12, 1990 in northern Quebec at Ungava Bay

52. A hunter reported a Canada goose band from northeastern Pennsylvania, November 12, 1990.
FILE DATA: Banded July 15, 1990 at James Bay in northeastern Ontario.

53. A Canada goose was shot by a hunter 10 years after it was banded in eastern Maryland near Baltimore on November 12, 1990.
FILE DATA: Banded January 2, 1980 near Baltimore, Maryland.

54. A banded snow goose was found dead at a fox den in northeastern Massachusetts, October 27, 1990.
FILE DATA: Banded July 12, 1990 in northern Quebec at Ungava Bay.

55. A banded Canada goose was found injured on the northern coast of North Carolina, December 28, 1990.
FILE DATA: Banded July 21, 1984 in north central Labrador at Goose Bay.

56. A neck-collared Canada goose was seen by person in central New Jersey, November 28, 1990.
FILE DATA: Banded July 19, 1989 on the Bay of Fundy in southwestern Nova Scotia.

57. The band number of a Canada goose was read by people feeding geese in a city park near Montreal in southeastern Quebec, July 9, 1990.
FILE DATA: Banded on January 15, 1987 in southern Maryland on Chesapeake Bay.

58. A banded Canada goose was caught after being forced down and weakened by bad weather in southeastern Pennsylvania, December 30, 1990.
FILE DATA: Banded July 8, 1990 in southeastern Ontario.

59. A Canada goose was shot on October 21, 1990 in southeastern Virginia in a farmer's field 3 months after it was banded.
FILE DATA: Banded at Moonsonee at the southern tip of Hudson Bay in Ontario on August 15, 1990.

60. A banded Canada goose was found injured in Flint near southeastern border of Michigan, September 4, 1990
FILE DATA: Banded in near Wilmington in southeastern North Carolina on June 30, 1989.

61. A Canada goose was recaptured at the place of banding one year later in southeastern Ontario, June 22, 1990.
FILE DATA: Banded near Sudbury, Ontario on June 18, 1990.

62. Two neck-collared Canada geese were seen together near a highway at Norfolk in southeastern Virginia, January 5, 1991.
FILE DATA: Banded July 23, 1988 at east James Bay in west central Quebec.

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YUKON
NORTHWEST TERRITORIES
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
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OR
CA
ID
NV
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WY
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RI
MA
MEXICO

Real Computer - plotted Band Returns
BLACK BRANT
BANDED IN ALASKA, ALL YEARS, ALL RECOVERIES
AK
YUKON
NORTHWEST TERRITORIES
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
WA
OR
CA
ID
NV
MT
WY
UT
AZ
CO
NM
ND
SD
NE
KS
OK
TEXAS
MN
IA
MO
AR
LA
WI
IL
MS
MI
IN
KY
TN
AL
OH
WV
GA
FL
SC
NC
VA
PA
NY
ME
MEXICO
Reports from Geese Banded in Alaska
U.S. FWS Bird Banding
Laboratory, Laurel, MD

Real Computer - plotted Band Returns

CANADA GEESE

BANDED IN ALASKA, ALL YEARS, ALL RECOVERIES

Reports from Geese Banded in Alaska
U.S. FWS Bird Banding
Laboratory, Laurel, MD

Real Computer - plotted Band Returns

TUNDRA SWAN

BANDED IN ALASKA, ALL YEARS, ALL RECOVERIES

Reports from Geese Banded in Alaska
U.S. FWS Bird Banding
Laboratory, Laurel, MD

CENTRAL FLYWAY

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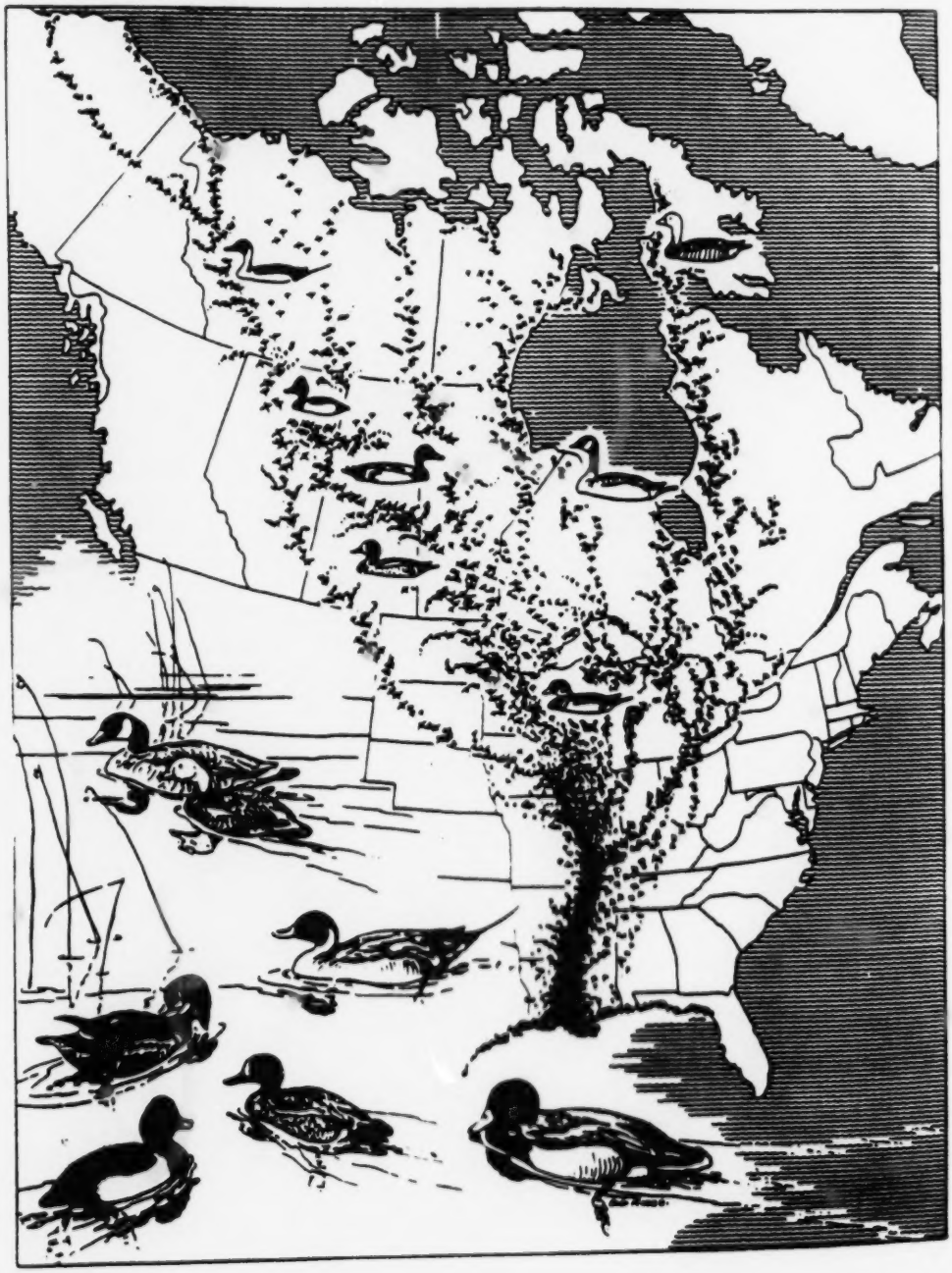
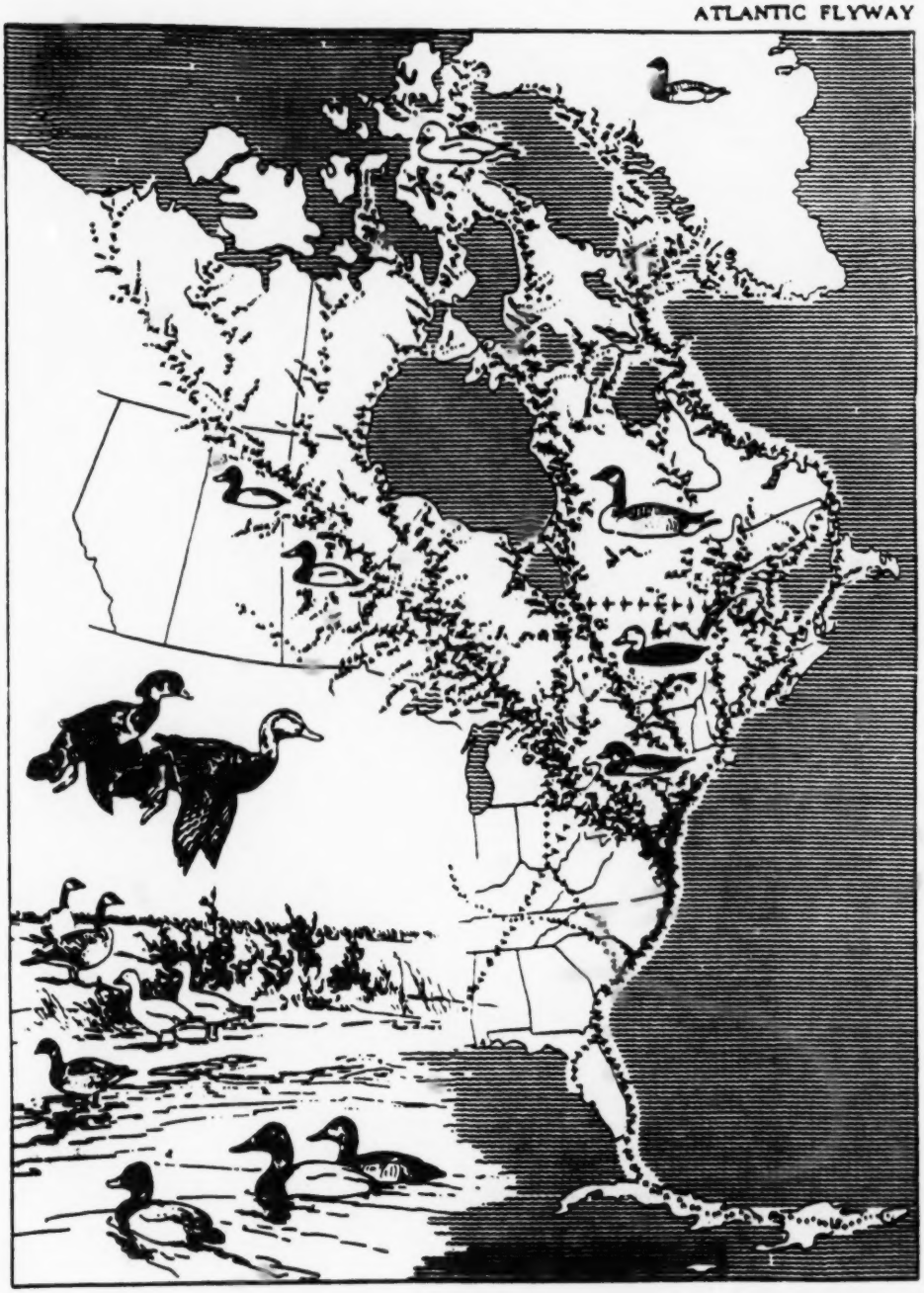
MISSISSIPPI FLYWAY



PACIFIC FLYWAY

ATLANTIC FLYWAY



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SAMPLING POPULATIONS

Objectives

Students will:
1. Learn about sampling techniques.

2. Learn why sampling is necessary.

3. Try different methods of sampling.

4. Discuss the effect of hunting on animal populations.

Method

Students will discover the difficulties of sampling populations by playing a simulation game.

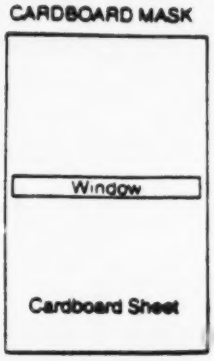
Background

Wildlife biologists make estimates of numbers of animals in populations of various species; this information is used to set harvest quotas. The theory is that a population can replenish itself if not too many of its numbers are taken. The **maximum sustainable yield** is the highest number of animals that can be taken from a population and still allow the population to replenish itself. Calculating the maximum sustainable yield requires knowledge of the population size. This knowledge is difficult to estimate. Estimates are made on the basis of sightings of the animal. These estimates can be difficult to obtain and may be inaccurate. The **counts** biologists make of ducks, geese, and swans in Alaska are actually an **index** of the total population. The surveys are designed so that the biologist can extrapolate from the index to get the **total population number**. Biologists count the same areas each year so the results can be compared. When populations have small numbers, the index may become the actual count.

Materials

- two one-quart jars of kidney or pinto beans
- cardboard sheet twice the length and the same width as an overhead projector light table
- overhead projector
- pencil
- masking Tape

Subjects: science
Skills: analysis, computation, research, comparing similarities and differences, interpreting data, observation, drawing conclusions, generalization
Duration: one class period
Group Size: whole class
Setting: indoors
Vocabulary: maximum sustainable yield, population
Topics: evidence of wildlife, hunting, wildlife management, population dynamics



Procedure

1. Before class, make a counting "mask" out of a sheet of cardboard twice the length and the same width as the light table on your overhead projector. Cut a strip 1 X 6 inches in the center of the cardboard. Now arrange beans on the light table in small clusters to simulate geese nesting.

2. Ask students how they would count a population of nesting waterfowl in Alaska. Explain that biologists use airplanes and conduct aerial surveys. It would be too costly and time-consuming to fly over all the areas where birds nest. So, they fly transects or strips over the area and count all the ducks, geese, and swans they see in that strip. They use that information to calculate the total population.

Turn on the projector and show students the beans representing the nesting geese. Position the cardboard mask over the light table so that only a strip of light shows along the top of the table. Have students count those beans appearing in the window. Move the mask down to another location and count again. On the basis of the beans they see, can the students estimate the total number? Take their guesses and ask how they made their guesses. Now try a different number of beans, either a great deal more or less, and repeat the estimations. Ask students to describe the difficulties in counting beans.

Based on this exercise, what does the class think are some of the problems in trying to count waterfowl populations? (You can't tell if you've counted individuals already, they live in areas that we can't always watch, etc.)

3. To demonstrate how a population estimate can be based on the energy expended to capture individuals, put some beans in a box lid. Have a student "hunt" for beans; using a pencil with a loop of masking tape on the eraser to pick beans out of the box one by one. They can be put into a jar once they are caught. Each time the student's pencil goes into the box counts as one attempt. What happens to the number of attempts to catch a bean as more beans are caught? (It takes more attempts to successfully find a bean, as fewer beans remain.) Explain the law of diminishing returns, which states that as a resource is used up, it takes increasing amounts of time and energy per unit to exploit what remains. In this way, hunter success can indicate population size.

Now "improve" the hunting technique (to simulate improved weapons and transportation): put a bigger piece of tape on the pencil eraser. Compare the energy to hunt now. It is much easier, and almost every attempt is successful.

4. Use beans, once again, to get across the effect of birth and death rates on population growth. Place two one-quart jars at the front of the classroom and divide the students into two groups. Students in one group will each add two beans to their jar, and students in the other group will add three beans at a time to their jar to represent two different birth rates. Compare how fast the jars fill up. Now demonstrate birth and death rates. Start with both jars full. Have each group add two beans at a time to their jars, but have one group take away one and the other group take away three to represent two different death rates. What eventually happens to the group with the three-bean death rate? (None will be left. This is obviously an extremely simplistic model.)

Point out that a high death rate can affect the population even when birth rates are constant.

5. Demonstrate the difficulty of gauging numbers by having half the class be birds and the other half be observers. Have the half that are birds go outside the classroom. The birds should decide how many will re-enter the classroom as a "flock." Have them enter for 30 seconds, leave again, and then re-enter with a different number. See if the observers can guess accurately how many birds there were each time. Switch groups after a few visits.

Ask Students:

* What problems did the observers have? (Sometimes they move so fast you can't identify and count them all; it is hard to know if you have counted the same animal before; you need to write down what you see in order to know how the population has changed.)

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* What kind of information can be gained from this type of study? (Birth and death rates, maternal behavior, social behavior, feeding habits, and movements.)

Evaluation

What are some of the difficulties in counting a population? Why do biologists want to count populations? Of what use is the information?

Reference

Alaska Sea/River Week, Volume VII. 1984. "Marine Mammals, Coastal & River Issues." Univ. of Alaska. Alaska Sea Grant.

Extensions

1. Invite biologist to class to describe how he or she counts wildlife and what problems may be encountered.

2. Use the information on Population Dynamics, in the Teacher Information Manual Part II, to demonstrate how biologists sample waterfowl populations through the course of the year.

FOWL PLAY

Objectives

Students will learn:
1. What information biologists can learn by doing research about animals.

2. That data from research is analyzed to find causes of a wildlife management problem.

3. That there may be several causes for one problem.

Method

In this investigation students will develop their analyzing and problem-solving skills by playing a game in which they employ wildlife survey techniques to determine the cause of a drop in a waterfowl population.

Background

In order to manage a population of a particular species and its habitat properly, biologists must carefully study the animal, its habitat, and the other animals associated with it. Surveys can help them learn about what the animal eats and where it lives, how and under what conditions it raised its young, and what diseases and parasites affect it. In this investigation, your students will analyze the hypothetical results of some of these kinds of research to determine the causes of a wildlife population problem at three different wildlife habitat locations. The problem has a different cause at each area, something that students will discover as they get involved in the exercise.

The information your students need in order to determine the cause of the drop in waterfowl populations at each location is on three different sets of cards: Habitat, Nest, and Bird.

Habitat Survey Cards can tell you the condition of food and water supplied and of other animals within the habitat.

Habitat Data Cards include food analysis, and results from studies on other animals trapped in the area.

Subjects: science, language arts, environmental studies
Skills: analysis, problem-solving, group interaction, research, discussion
Duration: 1 class period
Group Size: small groups, 1/3 of class in each group
Setting: indoors
Topics: wildlife research, environmental impact

Nest Survey Cards will show whether or not adults are laying eggs, if the young are hatching out of the eggs, and if the young are surviving their gosling or duckling stage.

Nest Data Cards include analysis taken during migration and egg-laying, during incubation, and while the young are in the nest.

Bird Survey Cards detect the presence of diseases, parasites, or poisons, and tell if the age and sex distribution (ratio of young to adult, male to female) of the population is normal or unusual.

Bird Data Cards include stomach content analysis, age and sex distribution analysis, and autopsy results.

Solution Cards provide students with the cause of the waterfowl population drop.

Materials

- Survey Cards - 3 copies, one copy of each card for each of three groups
- Solution/Data Cards one copy, one set per group
- 10 envelopes

Procedure

Before Class:

Follow these instructions to set up the cards for this investigation. Instructions are also printed on the card pages.

1. Make three copies of the sheet containing the Survey Cards.

2. Make one copy of the Solution/Data Cards.

3. Obtain ten envelopes.

4. Label three of the nine envelopes Minto Flats, three Copper River Delta, and three Aleutian Islands. For the three Minto Flats envelopes, label one Habitat Survey, one Bird Survey, and one Nest Survey. Do the same for the other two locations. Put the appropriate Survey Card and the three corresponding Data Cards into each of the nine envelopes. For example, Minto Flats Refuge Habitat Survey envelope would contain a Habitat Survey Card, and the three Minto Flats Habitat Survey Data Cards: Food Analysis, Water Analysis, and Trapping Other Animals.

5. Put all of the solution cards in the tenth envelope.

6. Keep all of the envelopes at your desk.

The situations described in the problem are based on historical or current declines that have occurred in these species. The procedures which your students will follow to find the cause of the population drop are similar to those a wildlife biologist might use. Offer help only by asking leading questions.

During Class:

1. Divide the class into three groups, one for each of the locations: Minto Flats, Copper River Delta, and Aleutian Islands.

2. Introduce students to the problem by reading the following information:

Here's the problem: Populations of different types of geese and ducks in three locations in Alaska have dropped dramatically. Your groups, serving as teams of wildlife researchers, must find out what has caused the population drop at your location. There are three general kinds of surveys you can conduct to begin the process: Habitat Survey, Nest Survey, or Bird Survey.

Habitat Survey Cards can tell you the condition of food and water supplies and of other animals within the habitat. Nest Survey Cards will show whether or not adults are laying eggs, if the young are hatching out of the eggs, and if the young are surviving their gosling stage. Bird Survey Cards will detect the presence of diseases, parasites, or poisons, and tell if the age and sex distribution (ratio of young to adult, male to female) of the population is normal or unusual.

3. Have each group follow steps a. through e. to solve the problem for its location (it may be helpful to write the steps on the chalkboard):

a. Before you begin the surveys write at least five possible causes for the goose population drop at your location. Beside each possible cause, write the name of the survey that you might use to gather information to prove your theory.

b. Decide which of the following three surveys you would like to conduct first: Habitat Survey, Nest Survey, or Bird Survey.

c. Get the Survey Card you want for your location and follow the directions given on it.

d. If you don't learn what caused the population decline from reading and discussing all three Data Cards for one survey, ask for another Survey Card envelope.

e. When you think you know what has caused the population drop, tell the teacher your theory. If you are not correct, go back and try again. If you read all of the Data Cards within all of the Surveys for your refuge and you are still not certain of the cause of the problem, make the best hypothesis you can and present it to the teacher. If the solution you suggest cannot be supported by the Solution Card, you may want to go back and analyze the data further. When you have the correct theory, you will be given the solution card which will tell you what you need to know to verify your conclusions.

4. The directions you have given will lead each group to the Survey Cards in the envelopes you have at your desk. Do not give any group more than one card at a time.

5. The Survey Cards should lead each group to the Data Cards labeled for its location. Each group may need to study all of the cards in all three of the data envelopes for its location before it has a probable solution.

6. When the groups have studied their Data Cards, they should have gathered the information they need to identify the probable cause of the problem. The information they need to verify their hypothesis is on the Solution Cards you have at your desk. Before giving any group its Solution Card, ask the students what they think is the probable cause of the decline. Give them the Solution Card only if the appropriate group wants to know the effects of weather or other factors on waterfowl or whether predators eat eggs and goslings or ducklings. If they aren't looking for the right information, they need to continue to use their Data Cards to analyze the problem. Students will not always come up with the right solution. You must decide how exact you want their hypothesis to be before giving them the Solution Card.

7. As the students work through this problem, they are not given some very obvious clues which wildlife biologists would normally have and which would help them decide where to start in their studies. For example, if the birds were dying as a result of toxins many different kinds of dead birds would be found. A biologist would probably decide to perform an autopsy right away. Information like this would probably eliminate some of the steps the students have to take in this exercise.

Use these questions to help the students analyze the process they have followed:

a. What was the first step each group decided to take to solve the problem? Why did each group choose that particular step?

b. Now that the causes of the population drop have been isolated, what possible solutions would each group pose? What further information would they need along the way?

What is the relationship between the animal, its habitat, and its reproductive capabilities?

Now that your students know what caused the population drop, what clues that they did not have initially would have helped them decide which survey to conduct first?

Evaluation

What type of survey would a biologist use to determine whether birds were eating poisons? If a biologist suspects hunting or predators to be the cause of a decline in bird populations, what evidence would be needed to support that theory?

Reference

CLASS Project. 1986. "Fowl Play." National Wildlife Federation.

Extension

Discuss what biologists have found out about each species and their management efforts from information in the Species Accounts, Teacher information Manual, Part II.

FOWL PLAY SURVEY CARDS

Make three copies of this page and cut each into three cards. Put one card into each location envelope with the corresponding Data Cards. Give only one Survey Card at a time to each group.

HABITAT SURVEY CARD

When a habitat is studied there are at least three things a wildlife biologist might do:
1. collect and analyze food samples,
2. collect and analyze water samples,
3. trap specimens of other animals which live in the habitat.

Each of the things may be analyzed to find out if there is anything abnormal occurring. Decide which of the three kinds of research listed above you want to do first, pick the appropriate data card from the Habitat Survey envelope, and discuss the information on it.

You may find that you need all three data cards in this survey envelope. If you do not have all the data you need after you review the three data cards for this survey, go to either the Bird Survey or the Nest Survey.

NEST SURVEY CARD

A wildlife biologist might conduct nest research at three different times:
1. during mating and egg laying,
2. during incubation of the eggs,
3. while young are in the nest.

If biologists perform research during mating and egg laying, they can find out if eggs are actually being laid. If eggs are not being laid, the female might be infertile.

You may find that you need all three data cards in this survey envelope. If you do not have all the data you need after you review the three data cards for this survey, go either to the Bird Survey or the Habitat Survey.

BIRD SURVEY CARD

When a wildlife biologist studies an animal species itself, he or she might do at least three kinds of research:
1. analyze the stomach contents,
2. perform an autopsy,
3. analyze the age and ratio of males to females in a population.

To analyze the age and sex distribution of a population the biologist would conduct trapping research. The biologist might find that there is an unusual ratio of young to adult birds, or perhaps an unusual ratio of male to female birds. Biologists could perform autopsies on animals to analyze the stomach contents and detect poisons in the system, diseases of the organs, or perhaps parasites. Decide which of the three kinds of research listed above you want to do first, pick the appropriate card from the Bird Survey envelope and discuss the information on it.

You may find that you need to study all three data cards in this survey envelope. If you do not have all the data you need after you review the three data cards for this survey, go either to the Habitat Survey or the Nest Survey.

COPPER RIVER DELTA

Make one copy of this page, cut the cards apart, and put them in the appropriate envelopes.

Situation: Dusky Canada goose populations declining.

SOLUTION CARD: Keep this card at your desk. This wildlife habitat area is located to the east of Prince William Sound. It consists of a large intertidal estuary system at the mouth of a large glacial river. In 1964, a large earthquake occurred, uplifting the area as much as six feet. Portions of the delta were uplifted beyond the reach of the tide. The wetlands dried out and now shrubs and trees are growing in former wetlands, providing cover for coyotes, bears, gulls, and jaegers who prey on eggs and goslings. As the vegetation changes, it is no longer good nesting habitat for the geese.

COPPER RIVER DELTA HABITAT SURVEY ENVELOPE

FOOD ANALYSIS DATA CARD

An analysis of the goose's favorite kinds of food shows nothing unusual. Based on a review of aerial photographs, the area of the location with shrubs or trees have increased by 20% since 1964.

If you did not get the information you need from this analysis, perform another analysis.

(Copper River Delta Habitat Survey Envelope)

WATER ANALYSIS DATA CARD

The water survey shows that the oxygen content is normal and the pH (acid level) is within acceptable ranges. There are no unusual chemicals in the water.

If you did not get the information you need from this analysis, perform another analysis.

(Copper River Data Habitat Survey Envelope)

TRAPPING OTHER ANIMALS DATA CARD

Most goose populations are shown to be down. However, the gull population is up by 40%, the bear population is up by 25%, and the coyote population is up by 34%.

If you did not get the information you need from this analysis, perform another analysis.

(Copper River Delta Habitat Survey Envelope)

COPPER RIVER DELTA NEST SURVEY ENVELOPE

DURING MATING AND EGG LAYING DATA CARD

The geese are breeding. Fertile eggs are being produced at the normal rate, five to eight per nest.

If you did not get the information you need from this analysis, perform another analysis.

(Copper River Delta Nest Survey Envelope)

DURING INCUBATION DATA CARD

Most nests show a 50 percent drop in the number of eggs in the nest over the four-week incubation period. No broken shells are in evidence around the nest.

If you did not get the information you need from this analysis, perform another analysis.

(Copper River Delta Nest Survey Envelope)

GOSLING DATA CARD

The nest has fewer young than normal. However, the goslings that are there are healthy and doing well.

If you did not get the information you need from this analysis, perform another analysis.

(Copper River Delta Nest Survey Envelope)

COPPER RIVER DELTA BIRD SURVEY ENVELOPE

STOMACH CONTENTS ANALYSIS DATA CARD

Nothing unusual is found in the stomachs of the geese. They are consuming the food common to geese.

If you did not get the information you need from this analysis, perform another analysis.

(Copper River Delta Bird Survey Envelope)

AGE AND SEX DISTRIBUTION ANALYSIS DATA CARD

Surveys show a very high number of adult birds and very few immature (young) birds. The sex distribution of the birds is normal.

If you did not get the information you need from this analysis, perform another analysis.

(Copper River Delta Bird Survey Envelope)

AUTOPSY RESULTS DATA CARD

An autopsy of several birds reveals nothing unusual.

If you did not get the information you need from this analysis, perform another analysis.

(Copper River Delta Bird Survey Envelope)

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MINTO FLATS

Make one copy of this page, cut the cards apart, and put them in the appropriate envelopes.

Situation: Pintail duck populations are declining nationwide.

SOLUTION CARD: Keep this at your desk. This wildlife habitat area is located in interior Alaska. Drought in the central United States has limited pintail nesting habitat. During drought years some ducks fly all the way to Alaska. Because of this, the proportion of the total North American population that nest successfully in Alaska increases. Managers suspect that many birds don't nest successfully because they have exhausted their fat reserves on their long trip. Consequently, the total population is declining.

MINTO FLATS HABITAT SURVEY ENVELOPE

FOOD ANALYSIS DATA CARD

An analysis of the duck's favorite kinds of foods shows nothing unusual. Vegetation and small insects are plentiful and show no diseases.

If you did not get the information you need from this analysis, perform another analysis.

(Minto Flats Habitat Survey Envelope)

WATER ANALYSIS DATA CARD

The water survey shows that the oxygen content is normal and the pH (acid level) is within acceptable ranges. There are no unusual chemicals in the water.

If you did not get the information you need from this analysis, perform another analysis.

(Minto Flats Habitat Survey Envelope)

TRAPPING OTHER ANIMALS DATA CARD

A live-trapping survey shows the populations of other ducks are up. Other populations are relatively stable and none are shown to be unusually large or small.

If you did not get the information you need from this analysis, perform another analysis.

(Minto Flats Habitat Survey Envelope)

MINTO FLATS NEST SURVEY ENVELOPE

DURING EGG LAYING DATA CARD

Surveys taken right after egg-laying show that females have laid eggs. The eggs are normal.

If you did not get the information you need from this analysis, perform another analysis.

(Minto Flats Nest Survey Envelope)

DURING INCUBATION DATA CARD

During the four-week incubation study, it is found that the adults are behaving normally and the female is sitting on the eggs.

If you did not get the information you need from this analysis, perform another analysis.

(Minto Flats Nest Survey Envelope)

DUCKLING DATA CARD

During the duckling-rearing period, brood surveys count on an average number of ducklings.

If you did not get the information you need from the analysis, perform another analysis.

(Minto Flats Nest Survey Envelope)

MINTO FLATS BIRD SURVEY ENVELOPE

BREEDING GROUND SURVEY

The number of adult birds is much higher than average. You compare data with a refuge in the central U.S. and find out a higher proportion of the North American population is on your location than on average.

If you did not get the information you need from the analysis, perform another analysis.

(Minto Flats Bird Survey Envelope)

STOMACH CONTENTS ANALYSIS DATA CARD

Nothing unusual is found in the stomachs of the ducks. They are consuming the food common to ducks.

If you did not get the information you need from this analysis, perform another analysis.

(Minto Flats Bird Survey Envelope)

AGE AND SEX DISTRIBUTION ANALYSIS DATA CARD

Surveys show a very high number of adult birds and very few immature (young) birds. The sex distribution of the birds is normal.

If you did not get the information you need from this analysis, perform another analysis.

(Minto Flats Bird Survey Envelope)

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ALEUTIAN ISLANDS

Make one copy of this page, cut the cards apart, and put them in the appropriate envelopes.

Situation: Aleutian Canada goose population endangered.

SOLUTION CARD: Keep this at your desk. This wildlife refuge consists of the Aleutian Islands, the farthest southwestern extent of Alaska. In the 1930's, fox farmers turned arctic foxes loose on the islands so they could be harvested later for their furs. The foxes decimated the goose population which had no natural predators, preying on adults, goslings, and eggs. The adults have no defenses against the foxes.

ALEUTIAN ISLAND HABITAT SURVEY ENVELOPE

FOOD ANALYSIS DATA CARD

An analysis of the goose's favorite kinds of food shows nothing unusual. Water, vegetation, and small insects are plentiful and show no diseases or strange chemicals.

If you did not get the information you need from this analysis, perform another analysis.

(Aleutian Islands Habitat Survey Envelope)

WATER ANALYSIS DATA CARD

The water survey shows that the oxygen content is normal and the pH (acid level) is within acceptable ranges. There are no unusual chemicals in the water.

If you did not get the information you need from this analysis, perform another analysis.

(Aleutian Islands Habitat Survey Envelope)

TRAPPING OTHER ANIMALS DATA CARD

Seabird populations are down. Trap some arctic foxes which are not native to the island.

If you did not get the information you need from this analysis, perform another analysis.

(Aleutian Islands Habitat Survey Envelope)

ALEUTIAN ISLAND NEST SURVEY ENVELOPE

DURING MATING AND EGG LAYING DATA CARD

The geese are breeding. Fertile eggs are being produced at the normal rate, five to eight per week.

If you did not get the information you need from this analysis, perform another analysis.

(Aleutian Islands Nest Survey Envelope)

DURING INCUBATION DATA CARD

Most nests show a 50 percent drop in the number of eggs in the nest over the four-week incubation period. Broken shells are in evidence around the nest.

If you did not get the information you need from this analysis, perform another analysis.

(Aleutian Islands Nest Survey Envelope)

GOSLING DATA CARD

The nest has fewer young than normal. However, the goslings that are there are healthy and doing well

If you did not get the information you need from this analysis, perform another analysis

(Aleutian Islands Nest Survey Envelope)

ALEUTIAN ISLAND BIRD SURVEY ENVELOPE

STOMACH CONTENTS ANALYSIS DATA CARD

The geese were consuming the food most common to geese.

If you did not get the information you need from this analysis, perform another analysis.

(Aleutian Islands Bird Survey Envelope)

AGE AND SEX DISTRIBUTION ANALYSIS DATA CARD

Surveys showed that there is a decreased number of adult and immature (young) birds. The ratio of male birds to female birds is normal.

If you did not get the information you need from this analysis, perform another analysis.

(Aleutian Islands Bird Survey Envelope)

AUTOPSY RESULTS DATA CARD

An autopsy reveals the presence of oil in and on both the male and female geese.

If you did not get the information you need from this analysis, perform another analysis.

(Aleutian Islands Bird Survey Envelope)

THE BRANT GAME

Objectives

1. Students will learn that the decisions about wildlife use and habitat development made by everyone have a cumulative effect on wildlife populations. They will learn the concept by playing a game that simulates the cumulative effects of these decisions throughout the summer, winter, and migratory range on a population of brant geese.

2. Students will practice addition, subtraction, multiplication, and division skills by calculating changes in population size.

3. Students will practice graphing information and interpreting graphs by working together on a graph of population changes.

Method

Students play a board game that simulates bird migration and the effects decisions about wildlife use and habitat development may have on the migrating bird population.

Materials

- Brant for the Future Migration board
- Choices for the Future cards (Question, Role and Decision-Yes)
- graph paper
- pencils
- dice

Procedure

1. First explain to students that people make decisions every day that affect the future of wildlife populations. Often the decisions involve a choice between doing or not doing some course of action that will provide people with certain benefits at a cost to some wildlife population or habitat. Usually, the choices are carefully considered. Sometimes the decisions are in favor of people, sometimes in favor of wildlife. Inform students that they are going to get a chance to discuss some hypothetical choices and make some decisions that will affect the future of people and wildlife.

Subjects: science, mathematics, social studies
Skills: decision-making, role-playing, computation
Duration: two to three class sessions
Group Size: small groups
Setting: classroom
Vocabulary: population
Topics: conflicting points of view, conservation, habitat loss, population dynamics, management of waterfowl

Divide the class into small groups. Assign all groups but one to one of the areas (or two if your class is small) identified on the Brant for the Future Game Board. Give to all of the groups -- except for the Flyway Council group the Choices for the future cards (Question and Role cards) for their area or areas. The last group will represent the Pacific Flyway Council and must have five members. Assign a student in this last group to Alaska, California, Mexico, Washington, and Oregon. Allow 10 minutes for all the groups to discuss the questions on their cards and decide yes or no to each question. At the end of 10 minutes, each group must report their decisions to their representative on the Flyway Council.

2. Briefly, discuss the concept of a wildlife population and the biology of the brant. (Use information in the Pacific Brant Account in the Teacher Information Manual, Part II, or information on the next pages.)

3. All groups except the Flyway Council group will investigate what happens to the brant population under natural conditions. Assume a starting population of 10,000 brant. Draw the axes for a graph on the blackboard. Divide the X axis into 20, 1-year increments. Divide the Y axis into increments of 500, from 5,000 up to 15,000. As the geese "migrate", have the group assigned to each area toss the dice, read the instructions aloud, and make the calculations for what happens when the brant move into their area. Students within the groups can take turns tossing the dice and calculating changes in population size. Instructions for calculating population changes are on the game board. At the end of each "year" when the population has returned to a wintering area, have one student graph the new population size on the blackboard graph. Repeat this for 5-10 years (spring migration, nesting, fall migration, and wintering). What happened to the population over these 10 years? Have the class discuss what happened to cause the population changes.

4. Inform students that the brant population has fluctuated in numbers for thousands of years. A growing human population and development throughout the brant's range have been relatively recent factors affecting brant populations. Over the next 10 "years," they'll find out how the choices they all made earlier will affect the future of the brant population. Choices about new development projects will add to past effects in a cumulative manner.

While the game is being played have the Flyway council group use the instructions on the Decision cards, instead of the calculation instructions on the game board. They will play the game separately from the rest of the class for the same number of years rotating the tasks of reading instructions, making calculations, and graphing the year-end population size.

5. When both groups have finished, inform students that brant populations have fluctuated in numbers for thousands of years. Growing human population and development throughout the brant's range have been relatively recent factors affecting brant populations. Tell the students they will find out how the choices they made earlier would affect the future of the brant population. Choices about new development projects will add to past effects in a cumulative manner.

6. Compare the graphs made by playing the game with natural fluctuations and with the human decisions that affected the habitat of the population. Discuss what happened to the brant population during each period. Why did it decline when all human decisions were yes? Who is responsible? Have the group from each area examine whether the choices they made contributed to a population decline.

Evaluation

Have students write an essay explaining whether or not they think that individual actions, which alone do not make a difference on the size of populations, can have any effect in the long run on populations.

Review what the students have learned about the dynamics of the brant population by listing, as a class, all the periods of the brant life cycle when birds are gained or lost to the population. (nesting: gain and loss; fall migration: loss; wintering: loss; spring migration: loss). After each period, list factors that could lead to gain and loss. (See Teacher Information Manual, Part II, Aspects of Population Dynamics.)

Extension

Have the class construct a population dynamics model on the board like the one shown in the Teacher Manual, Part II, Aspects of Population Dynamics. At each stage of the life cycle, ask the question: will the population grow or get smaller? How?

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BRANT FOR THE FUTURE

Instructions

1. Toss the die to begin migration. Move Marker 1 the appropriate number of squares shown. If the marker lands on a square with a pattern, match the pattern to the appropriate factor (Weather, Predation, Diseases and Parasites, Accidents, or Human Activities). Toss the die and read the key to find out what percent of the brant in your population died due to that factor. Calculate the change in the population size. New Population Size = Population Size minus Number Dying. Number Dying = (Population Size X percent dying) divided by 100. Repeat this step for each marker (population).

2. Whenever the marker passes a Staging Area, the flock must stop. Follow the instructions on the associated square (or, when using Decision cards, the appropriate Decision Yes Card) to determine the number that die, or the number of young produced.

3. When a marker reaches its nesting area, follow the instructions in the Nesting Area Box (or Decision Yes card) to calculate: 1) the number of nonbreeding birds, 2) the number of nests, 3) the number of successful and unsuccessful nests, and 4) the number of young produced.

4. Add together the number of nonbreeders and the number of failed nesters to obtain the number of molting birds. This portion of the flock moves on to the molting area. Toss the die, move, and calculate the number of birds killed by any factor as the proportion of the number of molting birds.

5. After reaching the molting area and calculating the number of brant dying there, toss the die to begin the return migration. The molting birds return to the nesting area to rejoin the rest of their population. Add together the number of successful nests -- times 2 to get number of successful nesting birds -- number of young produced, and number of survivors from the molting area. This total flock now continues south, stopping enroute at the Staging Area and each Wintering Area. Based on the results of your toss of the die, calculate any losses at the Staging Area or Wintering Area in terms of the proportion of this migrating flock.

6. Upon reaching a wintering area, follow the instructions in the box to determine how many can winter in the area and how many must fly further south. Then move the marker representing those that must fly furter south and calculate any deaths in a wintering area as the proportion of this new number (in each wintering area). Once the entire flock has reached a wintering area, a new year begins. Those in the farthest south wintering area begin migrating and are joined by the others in their population as they pass the other wintering areas.

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ARCTIC TUNDRA NESTING AREA

Toss the dice to determine the number of successful nests, and the average number of young produced per nest:

1 or 2--A late spring makes good nesting sites scarce, and most nests are accessible to predators this year. Only 24% of the nests are successful and only 1.5 young are produced per successful nest.

3 or 4--Weather is moderate, but the vole population is low, so foxes, jaegers, owls, weasels, and other predators switch to preying on bird nests. Only 36% of nests are successful, and 2.3 young are produced per nest.

5 or 6--An early break-up provides excellent nesting conditions. 62% of nests are successful, and 4.2 young are produced per nest.

WASHINGTON COAST WINTERING AREA

This bay provides a rich marine environment. Salt marshes around the edges and undeveloped areas provide good wintering habitat for brant and other birds. 20% of your flock can winter here.

TESHEKPUK LAKE MOLTING AREA

All geese molt their wing feathers all at once and become flightless for a few weeks each year. Successful nesters undergo their molt while on the nesting grounds, but non-breeders and failed nesters move to particular molting areas that provide abundant food and safety from predators. Teshekpuk Lake and the surrounding large lakes are one of the most important molting areas in Alaska. Geese travel to this area from as far away as the Yukon-Kuskowkim Delta, Canada, and even Siberia. The molting area is critical for geese, because molting their feathers requires extra nutrients and energy, and because the geese must gain enough weight for the long migration back to the staging, and eventually, wintering areas.

The availability of food , weather, numbers of predators, disease outbreaks, and amount of disturbance at the molting area determines the health and survival of the brant both at the molting site and during the southbound migration.

Toss the dice to determine the survival and health of the molting geese.

1 or 2--A year of bad weather and rough water causes the flightless geese to stick closer to shore so many fall prey to foxes and other predators. 3% die. Also, the cold weather requires more energy for keeping warm, so birds are not able to put on as much weight. The percent killed on the return migration to the staging area should be increased by 1%.

3 or 4--A year of moderate weather and most geese are able to survive and put on weight. However, a disease outbreak occurs. 1% die. Increase the % killed on the return migration to the staging area by 0.5%.

5 or 6--Good weather, plenty of food, and few predators. Only 0.3% die. Reduce the percent killed on the return migration by 1%

TESHEKPUK LAKE MOLTING AREA - DECISION YES CARD

You decided to allow oil exploration and development in this critical goose molting area. Oil was discovered and now many people are in the area building roads, pipelines, oil wells etc. Helicopter traffic overhead is constant. Some areas once used by geese are now intensively used by people. The geese have been forced out of these areas and are more crowded in other areas. This makes the potential for disease outbreaks more serious, and also means that the amount of food available for each goose is less. Garbage dumps have increased the amount of winter food available for foxes and their populations have increased. So more geese are killed by predators.

Toss the dice to determine the survival and health of the molting geese.

1 or 2--A year of bad weather and rough water causes the flightless geese to stick closer to shore so many fall prey to foxes and other predators. 2.5% die. Also, the cold weather requires more energy for keeping warm, so birds are not able to put on as much weight. In addition, disturbance by people causes stress and many birds are unable to gain adequate weight. The percent killed on the return migration to the staging area should be increased by 1.8%.

3 or 4--A year of moderate weather, most geese are able to survive and put on weight. However, a disease outbreak occurs. Because the geese are crowded into a smaller area, 3% die. In addition, disturbance and stress cause many to leave in poor condition. Increase the % killed on the return migration to the staging area by 1.5%.

5 or 6--Good weather, plenty of food, but foxes are abundant. 1% die. Disturbance of nesting birds causes stress, and despite good food supplies, there are more geese than the amount of available food. Many leave the area at a reduced weight. Increase the number killed on the return migration by 0.5%.

ARCTIC TUNDRA- DECISION YES CARD

You decided to allow and encourage mineral exploration. As a result, the area is booming with human activities. Helicopters carrying exploration crews and equipment whirr overhead. Many people have moved in to work on the mineral exploration projects. Roads have been built to a few sites where mineral deposits were found. Some areas have been changed by construction of building pads, work pads, etc. Loss of nesting habitat reduces the number of geese that can find nesting sites, and disturbance of some of the geese causes some nesting failure. Garbage dumps have grown and provide food for various animals, so populations of gulls and foxes have increased.

Toss the dice to determine the percent of successful nests and average number of young produced per nest:

1 or 2--A late spring makes good nesting sites scarce; most nests are accessible to predators this year. In addition, disturbance of nesting birds causes many to fail. Only 15% of nests are successful and on average 0.5 young are produced per nest.

3 or 4--Weather is moderate, but the vole population is low, so foxes, jaegers, owls, weasels, and other predators switch to preying on bird nests. In addition, much disturbance of the nesting birds causes nest desertions and makes eggs easy prey for the now abundant gulls and foxes. Only 28% of nests are successful, and 0.5 young are produced per nest.

5 or 6--This would have been a good production year as weather was mild, but disturbance of nests caused desertions and predation. Only 43% of nests were successful, and 2.2 young are produced per nest.

WASHINGTON COAST WINTERING AREA - DECISION YES CARD

You chose to allow development of the port in order to allow shipping traffic into your town. The heavy ship traffic, along with increased population of your area, causes water pollution and disturbs brant as they stop here. There is less food available as a result of the pollution and most brant move on. Only 6% of your flock can winter here now.

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YUKON-KUSKOKWIM NESTING AREA

Toss the dice to determine the number of successful nests, and the average number of young produced per nest:

1 or 2--Heavy rains and late break-up cause flooding over much of the delta. Many nests are destroyed by the flood waters. Only 30% of nests are successful and 1.5 young produced per nest.

3 or 4--Weather is moderate, but the vole population is low, so foxes, jaegers, owls, weasels, and other predators switch to preying on bird nests. Only 40% of nests are successful, with 2.6 young produced per nest.

5 or 6--An early break-up provides excellent nesting conditions. 65% of nests are successful.

OREGON COAST WINTERING AREA

The productive saltmarshes around this bay provide food for brant, and safe places for wintering. 20% of your flock can winter here.

IZEMBEK LAGOON STAGING AREA

This staging area is used by nearly all the brant in the entire Pacific flyway, both in spring and in fall. This area has one of the largest eelgrass beds in the world. The surrounding land is protected by National Wildlife Refuge Status. The area is critical for brant because they must put on enough weight to fly from here to the coast of Washington without any further access to food in the fall. And in spring they must regain the weight lost while flying north in order to be in good shape for nesting, or the further migration to the nesting area. This long over-water journey can be very taxing, especially if the weather is rough.

Toss the dice to find out how the brant fared on their stop at this staging area:

1 or 2--Poor weather during the staging period forces brant to migrate south early and reduces the weight gain of young birds and those in poor health. Increase the percent killed by any factor enroute further north or south by 0.5%.

3 or 4--Moderate weather so birds depart in good shape. Do not change the percent killed by any factor enroute further north or south.

5 or 6--Excellent weather allows brant to linger in the staging area late and put on extra amounts of weight. Even young and unhealthy birds depart in pretty good shape. Reduce the percent killed by any factor by 0.5%.

IZEMBEK LAGOON - DECISON YES CARD

You decided to allow oil exploration and development in the Bering Sea and Bristol Bay area north of Izembek Lagoon. The entire population of brant is crowded into this single area each spring and fall and biologists fear that an oil spill could seriously hurt the population. Also, an oil spill could harm the eelgrass beds and destroy this critical source of food. It is impossible to predict whether or not an oil spill will occur. If any major oil spill was swept into the bay at the wrong time, it would likely destroy the population. Fortunately, no such spill has occurred. But, small oil spills, leaks, and other problems are inevitable.

Toss the dice to find out how the brant fared on their stop at this staging area:

1 or 2--Only tiny amounts of oil have been spilled. Most oil has been quickly cleaned up, and little has reached Izembek Lagoon. Still, even tiny amounts of oil can ruin the insulation qualities of a brant's feathers. A few birds do get oil on their feathers and die. Calculate the number that die as 0.2% of the population. Also, due to poor weather, some brant don't get enough food before heading on. Increase mortality from any factor between here and their nesting or wintering area by 0.5%.

3 or 4--A small oil spill occurs during midwinter. Most of the oil is swept off to the west of Izembek, but a portion of the eelgrass bed is killed by oil that floats in. When the geese return, there is less food available, so some leave the area in poor condition. A few also get small amounts of oil on their feathers. Increase mortality from any factor between here and their nesting or wintering area by 0.5%.

5 or 6--A small oil spill occurs and is washed into the lagoon. It is washed into an area that is not frequently used by brant. All the activity to clean up the spill stirs the geese up; some depart early, and some get mixed up with the spilled oil Calculate the number dying as 4% of the population. Most brant are unable to gain enough weight. Increase the percent killed by any factor between here and their nesting or next staging area by 1%.

YUKON-KUSKOKWIM- DECISION YES CARD

You decided not to restrict the amount of disturbance and spring harvest of birds. Over the years, the number of people in the area has grown, so many more people are disturbing and harvesting geese.

Toss the dice to determine the number of successful nests and the average number of young produced per nest:

1 or 2--Heavy rains and late break-up cause flooding over much of the delta. Many nests are destroyed by the flood waters. Some of the few remaining birds are harvested by people. Only 13% of the nests are successful, and only 0.7 young are produced per nest.

3 or 4--Weather is moderate, but the vole population is low, so foxes, jaegers, owls, weasels, and other predators switch to preying on bird nests. In addition, much disturbance of the nesting birds causes nest desertions and makes eggs easy prey for predators. Only 28% of the nests are successful, and only 1.2 young are produced per nest.

5 or 6--This would have been a good production year as weather was mild, but many adults were harvested and disturbance of nests caused desertions and predation. Only 41% of nests are successful. An average of 2.5 young are produced per nest.

OREGON COAST WINTERING AREA - DECISION YES CARD

You chose to fill in the wetlands around the bay in order to provide more land for homes and businesses. Only a small wetland area remains anywhere in the bay. Only 10% of the brant in your flock are able to winter here. Because others are unable to find enough food to carry them further on migration, more die due to the effects of weather, predators, and other causes. Increase the percent of brant killed by any factor between here and the next wintering area by 1%.

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SEWARD PENINSULA NESTING AREA

Toss the dice to determine the number of successful nests, and the average number of young produced per nest:

1 or 2--Due to poor weather on the migration route, many birds arrive late. Many late-hatched young die when the lakes freeze over before they are old enough to fly. Only 24% of nests are successful, 1.8 young produced/ nest.

3 or 4--Weather is moderate, but the vole population is low, so foxes, jaegers, owls, weasels, and other predators switch to preying on bird nests. Only 36% of nests are successful, 2.3 young produced/nest.

5 or 6--An early break-up provides excellent nesting conditions. 60% of nests are successful, 4 young produced/nest.

CALIFORNIA COAST WINTERING AREA

This lagoon provides an undisturbed area of calm water, and adequate salt marsh habitat for wintering brant. 20% of your flock can winter here.

MEXICO WINTERING AREA

This lagoon provides excellent winter habitat for brant. Salt marshes and little human activity make it an ideal location. The remainder of your flock winters here. Because so many brant winter here, it is also popular with waterfowl hunters. 2% are killed by hunters.

CALIFORNIA COAST WINTERIN AREA-DECISION YES CARD

You chose to dredge the channel to allow faster access in and out of the lagoon. As a result, some of the saltmarsh in the lagoon was lost. Also the increased boat traffic in the lagoon disturbs the brant, and most do not stay. Only 3% of your flock winters here, the rest move on.

MEXICO WINTERING AREA-DECISION YES

You chose to develop the resort. Many more tourists travel to the area and sightsee in the lagoon by boat. Additionally the number of hunters traveling here to hunt has increased. The resort owners do not want to limit the use of the lagoon by boats or the number of visitors or hunters because they think that would hurt their business. As more hunters now visit the area, more brant are harvested. Also, many brant are forced to move elsewhere as a result of the disturbances--but there are few undisturbed areas remaining. Those that exist are over-crowded, so the brant are poorly nourished, and disease outbreaks are frequent. 7% of those that would have wintered in this area die of a variety of causes.

SEWARD PENINSULA-DECISION YES CARD

You decided to expand the reindeer herding project and allow reindeer to move through and use wetland areas where the geese nest. Over the years, more and more people have become involved in the project, so there has been greater and greater pressure to expand it. Many areas where geese once nested are no longer suitable habitat due to grazing and trampling by reindeer. Additionally, reindeer trample some of the nests each year. Also, the population in this area has grown with the reindeer herding project. As a result, more brant are harvested and disturbed each year.

Toss the dice to determine the average number of young produced per nest:

1 or 2--Late arrival of the birds combined with reindeer use of their nesting area, causes many nests to fail. Only 15% of nests are successful, and only 1.0 young produced/nest.

3 or 4--Weather is moderate, but the vole population is low, so foxes, jaegers, owls, weasels, and other predators switch to preying on bird nests. In addition, disturbance of the nesting birds by reindeer causes nest desertions and makes eggs easy prey for predators. Only 27% of the nests are successful, and only 2.1 young produced/nest.

5 or 6--An early break-up provides excellent nesting conditions. However, predators take many eggs and some nests are trampled by reindeer. Only 42% of nests are successful, and an average of 3.1 young are produced per nest.

Arctic Tundra of Northern Canada

Question: Should oil exploration and development be allowed on a coastal river delta near your town?

Role 1. You are in favor of encouraging oil development because it will likely mean more money for your transport company. Also you think that your country needs more oil so that it won't have to rely on foreign countries for this resource.

Role 2. You have mixed feelings about the proposed development. It will likely change the culture and lifestyle of many people in your town, but at the same time it will mean more money for people in the area, better educational facilities, and other benefits.

Role 3. You are opposed to the proposed development project because you love wild areas and do not want them changed by roads, gravel pads, the noise of drills, trucks, and people. Also you think people could get along with less oil if they conserved more.

Role 4. You are in favor of the proposed development because it will mean 800 new jobs for the community and many people are now unemployed or do not have enough money to buy things they need.

Role 5. You are concerned about the effects of the proposed development on wildlife habitat and populations. You realize that loss of habitat will mean less wildlife for people to enjoy and use.

Teshekpuk Lake

Question: Should oil exploration and development be allowed?

Role 1. You think development of natural resources for human use is inevitable and that more people should recognize this and quit trying to control or limit developers.

Role 2. You are a biologist and know that this is a very critical area for molting geese. You can't predict exactly how development will affect the geese but think it is very likely that repeated disturbance by aircraft, and other human activities will cause stress and the birds may abandon this important molting area.

Role 3. You are a government representative in charge of producing the maximum amount of revenue for the government from federal land holdings. Taxes on the oil that might be extracted from this area could yield millions of dollars of revenue.

Role 4. You represent a large company that wants to drill oil wells in this area. Your company will have to spend millions of dollars to develop the resource, but eventually will earn millions more in profits. You point out the benefits of development such as extra money for the state of Alaska that could be used to pay for social programs, the arts, education, etc.

Role 5. You are a resident of a nearby village whose family has used the area for a fish camp for many years. You are concerned that you will no longer be able to use the area if oil development occurs. You also know that oil develoment could provide a low-cost energy source for your village.

Seward Peninsula

Question: Should the reindeer herding industry be expanded and reindeer herds allowed to graze in wetland areas used by migrating and nesting waterfowl?

Role 1. You are a stock holder in the corporation that wants to expand the reindeer herding project so you could benefit financially if this project is approved. However, you also enjoy hunting waterfowl and are concerned about whether or not this project will affect the nesting birds.

Role 2. The value of an expansion of the herding project seems very clear. You and many others will likely earn more money which you need in order to buy things you need and send your children to college.

Role 3. You are a biologist in charge of maintaining healthy populations of all wildlife. Research results are not entirely clear, but if reindeer herding is done on a large scale there is little doubt that it would affect the nesting habitat for geese.

Role 4. You are an exporter of reindeer antlers. You have a market for these items that far exceeds the current supply. You would like to see the herding project enlarged so that you can meet this demand and make more money.

Role 5. You remember the old ways, but want your family to have a chance in the new and changing world. You favor the reindeer herding project because you think it would bring in more money and opportunities.

An area on the Yukon-Kuskokwim Delta

Question: Should access to some wetland areas and harvest of geese prohibited in some areas?

Role 1. You are opposed to any limits or restriction because you and everyone else need to harvest geese and use the wetlands. This is an important part of your culture and provides an important source of food that you don't think could be replaced.

Role 2. While out hunting, you have noticed that there are not as many geese as in past years. You think there should be some limitations on goose harvest and access to their nesting areas, at least for awhile.

Role 3. You love to hear the geese return in the spring. You understand that hunting is an important part of the culture of the people who live here, but worry that if no young are produced, soon no geese will be available for you to watch or for others to hunt.

Role 4. You live in California and hunt brant in the fall. You are concerned about harvest on the nesting grounds and think the birds should be left alone to produce as many birds as possible for everyone to harvest in the fall.

Role 5. You are a land use planner for the regional Native corporation. You are trying to plan for economic development that will benefit your shareholders. You oppose access restrictions that limit options for mining or oil and gas development on corporate lands.

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Izembek Lagoon

Question: Should offshore oil development be allowed in an area north of the lagoon, which is part of a National Wildlife Refuge?

Role 1. You are responsible for maintaining the habitat and populations of wildlife in this area and know that an oil spill could be disastrous for the many birds that stop to feed here on migration and for the many birds that winter here.

Role 2. You are an avid waterfowl hunter and go out to Izembek to hunt every year. You are very concerned that an oil spill could harm the geese or the eelgrass at Izembek. You are a stockholder in the company that is seeking the permit for offshore development.

Role 3. You represent the company that wants to develop the offshore oil resources. You do not want to see any wildlife harmed by an oil spill either, but you think that your company's safety record and equipment for dealing with any oil spill are adequate.

Role 4. You think that enough wildlife habitat is protected already by federal refuges and parks. Everyone should get on with development now. You think we can't afford not to develop any potential oil field.

Role 5. You would like to see all oil development in Alaska stopped because you think it is just attracting more people to Alaska and ruining what all of us here have. You think that when there are more people, there is less for everyone.

Washington Coast

Question: The Chamber of Commerce has proposed building a shipping port in the large bay near your town in order to accomodate the growing shipping industry in your town. Should the port be built?

Role 1. You are the town mayor. Building the port facility will create 1500 construction related jobs, and will help revive the local economy of the town. If you can get the port approved, you think your next election will be assured.

Role 2. You are the president of a local nature club. Your members are opposed to the port development because you feel it will harm the beauty of the environment and the ducks, geese, and shorebirds that need the natural wetlands that now surround the bay.

Role 3. You are a small boat owner. You are opposed to the port development because you feel the big ships will crowd out the small boats and you won t be able to enjoy sailing anymore.

Role 4. You are an out of work construction worker. Your government benefits have almost run out and you aren't sure where you'll get the money you need to buy food for your 5 children. You think that construction of the port will provide a job for you and others.

Role 5. You are concerned about wildlife that use the bay, but from what you've seen the birds are only in the bay for a few weeks in the spring and fall, so you think that the bay can't be that important for them. Your brother is out of work and needs a job.

Oregon Coast

Question: Should the wetlands surrounding a large saltwater bay near your town be filled in to provide more land for homes and businesses?

Role 1. You are a wealthy real estate developer who is interested in building condominiums in the area once the wetland is filled. As far as you can see the land is a worthless swamp anyway. If it were filled in it could be worth millions of dollars.

Role 2. You are a birdwatcher. You have seen more and more wetlands in the area filled in over the past several years, and this is just about the only one left. If it is filled in, most birds will have to move elsewhere. You think the area should be made into a wildlife sanctuary.

Role 3. You rent an apartment in the town because you can't find any land to build a house on. You would really like to have a waterfront house so you could look out over the water.

Role 4. You are a member of the chamber of commerce. You'd like the town to expand and be able to attract more businesses. About the only remaining land that could be developed is the wetland area around the bay.

Role 5. You are an avid waterfowl hunter. You know that biologists think habitat loss is a probable factor causing declines of some goose populations. You want to be able to continue to hunt geese and realize that its up to you to protect their habitat in your town.

California Coast

Question: Should a channel be dredged out of the lagoon to shorten the distance boats must travel to reach the open sea?

Role 1. You are opposed to dredging the channel because it seems to you a waste of taxpayers money. There is already a channel that connects the lagoon and the open ocean and it only takes 20 minutes to use it even from the most distant part of the lagoon.

Role 2. You are a fisherman and would like to see the channel dredged because it would allow you to get out to sea faster when the weather was good and the season open. The fishing seasons for some fish are so short that every minute counts.

Role 3. You are a city planner and would like to see the dredging plan approved. In the long run you think it would mean more boats using the harbor and thus more revenue for the city.

Role 4. You would like to stop the dredging plan because it will ruin the saltmarsh habitat in the area. This will force a variety of wildlife that rely on the area to move elsewhere. You think the wildlife have more right to use the area than people do.

Role 5. You are the owner of a company that runs a dredge and would like to be able to bid on the dredging work once it has been approved. You expect that the contract will be for several hundred thousand dollars, and that would really help your business out.

A Bay in Mexico

Question: Should some businessmen be allowed to build a recreational hotel and resort for American tourists near the shore of a rich coastal lagoon?

Role 1. You are a very poor farmer. You do not really want to have American tourists around, but realize that your family could probably earn some much needed money by selling handmade items to the tourists or by working in the resort hotel.

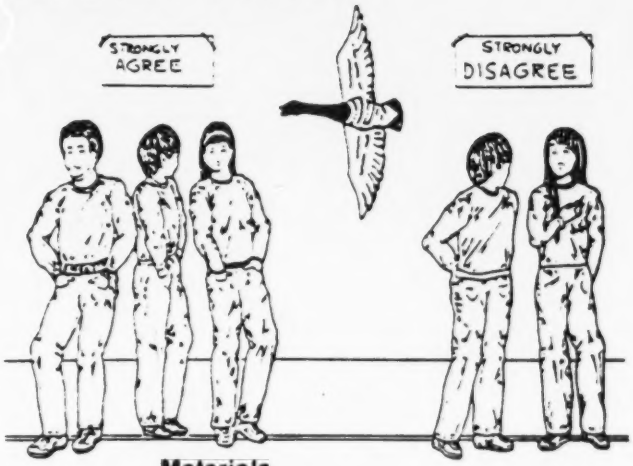
Role 2. You are an avid waterfowl hunter. You would like to be able to travel to this lagoon and hunt waterfowl because the hunting seasons and bag limits in Mexico are more liberal than in your home state. Since the resort hotel would provide air charter access and comfortable accomodations, it would make a dream hunting trip possible.

Role 3. You are a biologist concerned about waterfowl populations that have recently declined. One factor that may be contributing to the declines is additional hunting pressure in Mexico where some species overwinter. You heard about the proposed resort and are very concerned that it would increase the number of hunters that would travel to Mexico, and thus increase the harvest of waterfowl in Mexico.

Role 4. You are a leader in your town and want to help the many poor people of your town. The builders of the proposed resort have told you that they will hire local people for many of the jobs created by the resort development. They have agreed to help establish better medical facilities and schools ifyou will support the resort.

Role 5. You are a wildlife photographer and like to get away from towns and people in order to study and observe animals. This rich lagoon in Mexico has become one of your favorite places to photograph various wildlife. In addition to being upset that more people will be attracted to this wild area, you are concerned that the disturbance caused by so many people will drive the wildlife out of the area.

WHERE DO YOU DRAW THE LINE ? - MIGRATORY BIRDS



Objectives

Students will:

1. Form opinions about issues and explain their reasons for making choices.

2. Understand that different circumstances can change their opinions or actions.

Method

Students listen to a statement, decide their opinion about it, then place themselves on a line according to their opinion.

Background

The purpose of this activity is to encourage students to obtain information before forming an opinion. Teacher should **stress** that **there is no** right or wrong **opinion about these** questions. **Opinions based on logic, emotions, or philosophy are valid, as long as they are not based on incorrect information.** This activity is carefully written so that individual students will never be evaluated based on their opinions.

Materials

- masking Tape (15-20')
- "Strongly Agree" card
- "Strongly Disagree" card

Procedure

1. Place a long masking tape line on the floor (approximately 15 feet long). Put one card at one end, the other at the other end of the tape line. Read the first item on the list of statements. Students are to place themselves along the masking tape line according to their personal opinion of the statement. If they strongly agree with the statement, they stand closest to the "Strongly Agree" card, if they strongly disagree, they stand closest to the "Strongly Disagree" card. Students who have no opinion, or are somewhere in between a strong feeling and a neutral one can place themselves accordingly along the line. After students stand along the line, they should explain their reasons for standing where they are. Encourage discussion among students. Remember: there are no "right" or "wrong" answers in this game, unless opinions are based

Subjects: social studies
Skills: decision-making, discussion, values clarification
Duration: one to two class sessions
Group Size: large or small
Setting: outdoors or indoors in gym or hallway
Vocabulary: values, opinion
Topics: value of wildlife to people, people and wildlife sharing environments

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on misinformation.

2 The following statements include "warmup" examples and examples concerning the environment for which there is a diversity of opinion. If the majority of students have similar opinions about a statement, using variations of each statement will help them become aware that opinions are seldom "black or white" and that specific situations and circumstances can cause people to modify their opinions.

3 After reading the starred statements, pass out the numbered Bird Expert card which corresponds to the statement to a student who is at the "strongly disagrees" end of the line. Have the student read the card aloud and then ask the student to move along the line if their opinion has changed based on the information. Ask them how they would modify the statement so they could strongly agree with it after hearing the information.

For example:
Basketball is more fun than volleyball.
Variation: The basketball court is outside, the volleyball court is inside, and it's -30° F.

Cookies are better than ice cream.
Variations #1: A chocolate chip cookie is better than vanilla ice cream.
Variation #2: A fig newton is better than chocolate ice cream. If you're lost and starving in the wilderness in interior Alaska, and it's 80°F, would you rather have cookies or ice cream?

Ask the students to think of situations that would cause them to change their opinions.

Note: Some of the sample statements will be relevant to students living in urban environments in Alaska and some are relevant to Bush living. Choose the statements which are most familiar to your students and about which they are likely to have a range of opinions.

Statements:

- Basketball is more fun than volleyball.
- Cars are better than snowmobiles.
- Moose are better than horses.
- Cookies are better than ice cream.
- Playing basketball is more fun than playing baseball.
- Three-wheelers are better than snowmobiles.
- Bicycles are better than cars.
- Hunting is fun.
- Watching birds is fun.
- Everyone should be able to hunt any kind of waterfowl they want any time of the year if they are needed for food. (1)
- Alaska plays an important role in the recovery of waterfowl populations that have been declining.
- People should follow hunting regulations.
- People who live in Alaska can help protect the wintering areas of the birds that nest in Alaska.
- Farmers have the right to kill birds who are eating their crops.
- * Drought in North or South Dakota will not affect the birds that nest in Alaska. (2)
- * Pollution in the northeastern U.S. will not affect birds that nest in Alaska. (3)
- * We should kill predators such as foxes, gulls, or bears or if they are killing too many young birds.

Reference

Project WILD. 1986. Western Regional Environmental Education Council.

#1 Bird Expert Card

The U.S. signed treaties with other countries that limited hunting seasons to less than 3 1/2 months every year and closed hunting between March 10 and September 1 to protect birds when they were nesting and producing more young.

In Alaska, Native Alaskans have traditionally hunted geese and ducks in the spring. They are the first fresh birds of the year in many villages and arrive fat. Because of the importance of this food to people who subsist, or depend on it, the U.S. government has not enforced the treaty strictly. Both the government and Alaska Natives have been trying to change the treaties to make this traditional harvest legal.

On the Yukon-Kuskokwim Delta, where Yupik Eskimos have traditionally harvested several species of geese in the spring, they are now involved in a cooperative program to help restore the populations that were at very low levels. They are working with wildlife managers to educate people about the problem.

Alaska hunting regulations permit the harvest of animals for food during closed seasons in the case of situations where a person's life is threatened by starvation.

#2 Bird Expert Card

Several types of ducks that nest in Alaska also nest in the "prairie potholes" area of North America which includes several Canadian provinces and states in the central U.S. When drought occurs in this area, such as the severe drought in 1988, flocks of northern pintails, canvasbacks, and other ducks which cannot find a place to nest continue their migration to Alaska. The number of pintails in Alaska during the summer can increase by 60%!

Birds that "overfly" their normal nesting areas may be unable to nest and raise young in Alaska. They have used up fat stored during the winter in their long flight and may not have enough left over for the hard work of raising young.

#3 Bird Expert Card

Two different groups, or populations, of tundra swans nest in Alaska. The eastern population nests mainly on the North Slope and eastward into Canada. When these swans leave Alaska, they move southward and eastward, crossing eastern Montana and North and South Dakota, then on to Maryland, Virginia, and North Carolina.

Many of these swans spend the winter in Chesapeake Bay, a relatively shallow bay surrounded by 13 million people. Water pollution is a serious problem in Chesapeake Bay and it affects the plants fed on by the swans. Fishermen who live in North Carolina would like to stop the swans from feeding on oyster beds and people who grow cranberries in bogs in New Jersey are losing some of their crops to the swans. Lead poisoning and oil spills have also caused the death of swans in these wintering areas.

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#4a Bird Expert Card

The Aleutian Canada goose, which nests only in the Aleutian Islands, was endangered, but it has slowly recovered to threatened status. Fewer than 800 of these geese could be found in 1967. Scientists and managers were able to help the geese to increase to nearly 6,000 birds by 1990. Their main efforts involved eliminating foxes from islands where they had been introduced by people raising them on farms so they could sell their furs. When the price of furs became low, the farmers left the Aleutian Islands and many of the foxes were released. The geese had no defenses against the foxes so eventually, no geese were able to survive on islands where foxes lived. Removing foxes by trapping, shooting, and by the use of poison baits eliminated foxes from several islands and biologists have been able to reintroduce geese to these islands where they could survive and raise their young.

 # 4b Bird Expert Card

The dusky Canada goose, which nests only on the Copper River Delta, declined steadily between 1979 and 1990. In 1984, the population became so low that no hunting was allowed. Scientists studied the geese on their nesting grounds and found that few goslings survived because bears, coyotes, foxes, gulls, and jaegers were all feeding on eggs and goslings. These predators were increasing in numbers because the habitat had changed since an earthquake that occurred in 1964 and raised the area in elevation. As the areas dried out, shrubs grew which provided good cover for the predators.

Managers have tried transplanting the geese to different areas, building artificial nests on islands which the predators can't reach, and even moving bears away from the nesting areas, but none of these measures are enough to help the goose population recover while the habitat continues to be good habitat for the predators.

WHO DOES WHAT? -MIGRATORY BIRDS

FISH & WILDLIFE PROTECTION

Objectives

Students will learn:

1. Which natural resource agencies and other organizations are involved in the management of migratory birds.

2. Whether organizations are federal, state, or local.

3. The function of each organization.

Method

Students will play a card game to learn the functions of various organizations that participate in management decisions affecting wildlife.

Background

A confusing array of governmental agencies and conservation groups participate in management decisions affecting wildlife. Many have distinctive emblems and uniforms. Few people recognize the uniforms employees wear and which organization it represents. It can be difficult to learn and remember which groups have responsibilities for which wildlife management activities. This activity is designed to alleviate some of this confusion and to give students an opportunity to learn to recognize emblems and to clarify the functions of several groups.

Materials

- Organization Cards

Procedure

1. Begin by asking questions which relate to function and jurisdiction of federal, state, and local agencies and organizations that deal with wildlife. This may be done as a group or individually. If possible, invite guest speakers to talk to the school about their jobs.

2. Give the Organization Cards to the students. Some students will have cards with emblems and some will have cards with descriptions. Allow students to study the cards. Then ask the students to find their "buddy," the person

Subjects: science, social studies, careers
Skills: listening, memory, recognition of emblems
Duration: one to two class sessions
Group Size: small or large group
Setting: indoors
Vocabulary: agency, jurisdiction, authority

whose card pairs with theirs. (Option: Ask "buddies" to role play their organization for the students in the class.)

3. Construct a diagram on the board which shows who's involved in developing and enforcing hunting regulations for migratory birds. Questions to ask:

1) Who proposes a regulation (anyone can, Fish and Game Advisory Boards)?

2) Who makes the decision to adopt the regulation (The Secretary of the Interior)?

3) Who is involved in the decision [Flyway Council, Flyway Committee, Alaska Department of Fish and Game (ADFG), United States Fish and Wildlife Service (USFWS), the public]?

4) How are federal regulations made more specific to Alaska (Board of Game adopts with input from Fish and Game Advisory Boards and the public)?

5) Who enforces the regulations (Alaska Division of Public Safety)?

Evaluation

Hold up each card and ask students to correctly name the function and jurisdiction of each agency

ALASKA DEPARTMENT OF FISH & GAME
DIVISION OF WILDLIFE CONSERVATION

Although the U.S. Fish and Wildlife Service has primary responsibility for the protection and management of migratory birds, the Alaska Department of Fish and Game plays an active role in survey, research, habitat protection, and harvest management of migratory birds within Alaska. A state waterfowl biologist is a member of the Study Committee of the Pacific Flyway Council, and a state wildlife manager participates in decisions made by the Pacific Flyway Council. Alaska biologists also provide information to the Atlantic, Mississippi, and Central Flyway Councils, and occasionally to Pacific Rim countries, which manage many birds that nest in Alaska during migration or winter.

DEPARTMENT OF PUBLIC SAFETY
DIVISION OF FISH AND WILDLIFE PROTECTION

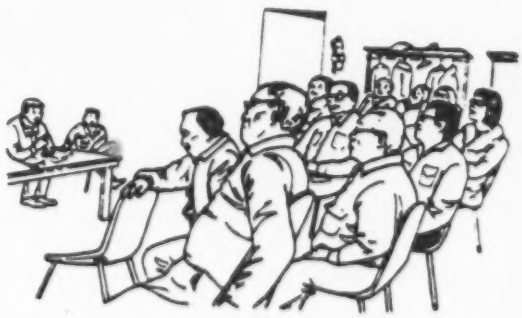
State fish and game laws passed by the Board of Game or Board of Fish are enforced by this agency. The main job of this agency is to inform people about the hunting, fishing, and trapping regulations and laws. Protection officers may give fines or arrest people who break the laws.

FISH & WILDLIFE PROTECTION

ALASKA BOARD OF GAME

The Board of Game is made up of seven members of the public appointed by the Governor who review proposals for hunting, hold public hearings, consult with the Alaska Department of Fish and Game, and adopt changes to the regulations. The federal government provides a federal "framework" of regulations each year for the hunting of migratory birds. This framework provides the Board some flexibility in setting bag limits and the timing of hunting seasons; however, they cannot adopt regulations that are less restrictive than those set by the federal government for hunting migratory birds.

Proposals for changes in regulations can be made by local advisory committees, the Alaska Department of Fish and Game, or by any member of the public.



Alaska Board of Game

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U.S. DEPARTMENT OF INTERIOR/U.S. FISH AND WILDLIFE SERVICE

The U.S. Fish and Wildlife Service has primary responsibility for the protection and management of migratory birds. "Service" biologists survey migratory bird populations and conduct research and are involved in habitat protection and harvest management. Alaskan Service biologists provide information to the Pacific Flyway Study Committee and participate in decisions by the Pacific Flyway Council. Results of research in Alaska are also provided to other Flyway Councils and to Pacific Rim countries which manage birds that nest in Alaska during migration or winter.

The state-federal Flyway Council recommends regulations each year to the Secretary of the Interior who then gives the public an opportunity to comment. The final federal regulatory "framework" is then adopted into law. The federal framework provides the earliest and latest dates for seasons, maximum number of days within a season, and the maximum number of birds a hunter can possess in a daily or total "bag."

PACIFIC FLYWAY STUDY COMMITTEE

The Pacific Flyway Study (or Technical) Committee is made up of the waterfowl biologists from the 10 Pacific Flyway states and a biologist from the U.S. Fish and Wildlife Service. Biologists from the Canadian Provinces, the Canadian Wildlife Service, and the government of Mexico also participate. This group helps the Flyway Council analyze data on populations, habitat conditions, and harvest trends. After analyzing the data, they forward recommendations for hunting regulations to the Flyway Council.

The Study Committee also cooperates to conduct research projects in the different states and to develop long-term management plans for different bird species. For example, biologists from Alaska and Oregon have worked together to conduct studies and develop a management plan for the dusky Canada goose which nests primarily on the Copper River Delta in Alaska and spends the winter in the Klamath Valley in Oregon. When the population began declining, information was needed from both areas to determine the cause of the decline and how hunting should be regulated to allow the geese to increase in numbers.

Pacific Flyway Study Committee

PACIFIC FLYWAY COUNCIL

The Pacific Flyway is an "administrative" flyway. Migrating birds don't always respect the boundaries of states, provinces or countries in their migration patterns; however, the councils came into being to allow biologists and managers in these different political administrative units to coordinate their efforts, particularly in managing harvests for the continued abundance of each waterfowl species.

The Council is made up of the directors of state wildlife agencies in 10 states and a U.S. Fish and Wildlife Service representative. The Council meets in March and July each year to make recommendations to the U.S. Fish and Wildlife Service about changes in hunting regulations or policy matters related to migratory bird management. They base their recommendations on those received from the Technical Committees. The Council and its committees work frequently with land-management agencies to address habitat issues.

The Pacific Flyway Council participated in development of the North American Waterfowl Management Plan which has been adopted by the U.S. government and the government of Canada. This plan sets continent-wide goals for populations of ducks, geese, and swans, and identifies needed actions to acquire and protect wetland habitat.

Pacific Flyway Council

FISH AND GAME ADVISORY COMMITTEES

Advisory committees are made up of people in a community or region interested in wildlife management. The committees provide information about local wildlife conditions to the Alaska Department of Fish and Game and propose regulation changes to the Boards of Fisheries, Wildlife, and Game.

FISH & GAME ADVISORY COMMITTEE

CAN DO!
- MIGRATORY BIRDS

Objectives

Students will:

1. Identify a problem involving migratory birds.

2. Suggest and evaluate alternative means to either solve the problem or improve the situation.

3. Undertake the project to solve the problem.

4. Analyze and describe the process by which they successfully solved the problem or improved the situation.

Method

Students select a migratory bird project, conduct research, make plans, and follow procedures to accomplish the project.

Background

This activity is designed for students to identify a local situation in which they can help migratory birds. The situation can either involve actual "hands-on" experience, like a feeder count program, or it may involve a political action project in which the students learn how to influence people in authority to carry out a desirable action for wildlife. The activity "Putting It All Together" focuses on the problem-solving and decision-making process.

Each of us can make constructive contributions to improving the environment in which we live. Sometimes our actions can improve the environment for people, sometimes for wildlife, and sometimes for both. Sometimes our effectiveness can be improved if we work with other people sharing ideas, information, and skills. A working knowledge of the following terms will be useful to students in this activity:

Problem: a difficult situation to be improved, or an opportunity to make things better. Problems can not always be "solved," but situations can usually be improved.

Subjects: social studies, language arts, science
Skills: analysis, discussion, evaluation, problem solving
Duration: three class sessions
Vocabulary: problem, authority, compromise, alternatives
Topics: responsible human actions, people and wildlife sharing environments

Authority: an individual or group of people with the power to make changes.

Compromise: a way to settle a problem in which both "sides" usually give a little.

Given that it is important for young people to learn that they "can do" for people, wildlife, and the environment, use your judgement in the course of this activity to assist students in selecting a project that is realistic, constructive, and possible. If not, the students may experience an activity that contributes to their thinking that they "can't do." The major purpose of this activity is to provide students an opportunity to experience success in taking constructive actions to improve the environment for people and migratory birds.

Materials

- writing materials

Procedure

1. Ask the students to think of some ways to improve local areas as homes for migratory birds. They might generate a list of activities on their school grounds or in their community that have a negative impact on birds. The list might include, litter that poses a hazard for birds, a proposed pesticide spraying that will not only kill the "pest" but perhaps affect birds, removal of plants that presently help contribute to cleaning the air, producing oxygen, and serving as food and cover sources for birds, etc.

2. Look at the list of possible bird habitat problems and the suggestions for ways to improve bird habitat at school. Ask the students to select one they think could realistically handle and do something constructive about. If they have difficulty deciding, and reasonable support has been offered for each, the students might vote to decide. Students could also make speeches in support of the problem they want to tackle, in hopes of swaying the class vote.

3. Once the problem has been selected, ask the students to work alone or in small groups to begin to generate ideas for possible solutions to the problem and ways to implement the project. Each individual or small group could come up with a plan, including written descriptions and sketches illustrating how to accomplish the project, step by step.

4. Ask the groups to present their plans to the rest of the students. Students may ask questions of the students. Once all the plans have been presented, ask the students to select the plan that seems most: a) constructive, b) realistic, c) helpful to birds, d) probable to make a lasting contribution.

5. Ask the students to select one or more alternative plans, in case their first choice is not acceptable to authorities at the school or village.

6. Once a plan (with alternatives for "back-up") has been selected, ask the students to select a delegation to present their proposal to the school principal or the appropriate authority. Remember to include janitors, grounds keepers, school board, etc. (anyone who would be physically and/or officially involved). A practice session before the students and any interested parents or other groups of students would be helpful. At the practice session, the student delegation would make their presentation as they plan to do before the principal, (janitor, council, etc.) responding to any questions from their audience that might be raised.

7. The students should make an appointment to present their proposal, make the presentation, and report back to their classmates. If their plan is accepted, they should make sure they know who to contact next in order to successfully complete their project. Making sure they have all necessary permissions secured, the students should proceed to successfully accomplish their project.

8. Once accomplished, ask the students to analyze their results. Did things work out the way the students wanted them to? Were there any surprises? Any unforseen problems? How might they have been any more effective?

Possible Community Projects Related To Migratory Birds

- Start a Young Waterfowler's (waterfowl hunting) program.

- Generate interest in a Hunter Education program for your community.

- Gather data during different seasons on which species migrate through your area, which breed there, and if any spend the winter there. Have students provide observations about the dates different bird species are first sighted each spring, the date certain plants are first observed turning green or flowering, the date break-up occurs in the river, etc. This information can be compiled over several years, average dates calcu-

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lated, and changes plotted on graphs and compared.

- Develop a map of good local birdwatching areas and the types of birds that can be found there at different seasons.

- Develop a Loon Watch program to protect nesting loons from disturbance or shooting. (Contact Nancy Tankersly, ADFG, 333 Raspberry Road, Anchorage, AK 99515 for more information.)

- Take part in the Audubon Christmas bird count in your community. Compare your results with those of other parts of Alaska and the country.

- Participate in the Cornell University feeder count program.

Reference

Project WILD. 1986. "The Monday Group, from Awareness to Action." Western Regional Environmental Education Council.

Extension

Document your project on video tape

STAMPS FOR BIRDS

Objective

Students will learn that federal and state Duck Stamps are a means to raise money to acquire and restore wetlands and manage them as wildlife habitat.

Method

Students will design and create a Duck Stamp and wetlands conservation message.

Background

"Duck Stamps" are a means for conserving wildlife habitat for waterfowl, many of whom depend on wetland habitats. Since 1934, waterfowl hunters have been required to purchase a federal stamp each year in addition to their state hunting license. Since 1985, a state stamp has also been required in Alaska. Many people who do not hunt, but who may enjoy watching birds or who collect art, also purchase the attractive stamps and prints. Federal Duck Stamps are available for purchase at post offices. Alaska Duck Stamps can be bought at locations where hunting licenses are sold.

The federal duck stamp program, formally known as the Migratory Bird Hunting and Conservation Stamp Program, is a successful long-term conservation program for wildlife. Between 1934 and 1984, over 300 million Duck Stamp dollars have gone to preserve more than 3.7 million acres of habitat for waterfowl in North America, including many acres of wetlands. Many of the more than 400 National Wildlife Refuges in the United States have been paid for entirely or in part by Duck Stamp receipts. Designed as a program to benefit waterfowl, and known as the "Duck Stamp" program, sales of the stamps have benefitted many other fish and wildlife species that depend on wetland and upland habitats provided by the program. The program has also benefitted humans by preserving the other important functions and values of wetlands.

The federal program was established in response to drastic declines in waterfowl that oc-

Subjects: art
Skills: drawing, use of media
Duration: one class period
Group Size: individual
Setting: indoors
Vocabulary: Duck Stamp, refuge, conservation
Topics: habitat, wildlife management, conservation

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curred after the Dust Bowl droughts of the 1920s and the rapid draining and conversion of wetlands throughout the country as America was settled. In 1929, a federal law was passed that authorized expansion of the existing National Wildlife Refuge System, but no funds existed to purchase privately-owned land.

A cartoonist, J.N. "Ding" Darling came up with the idea of the Duck Stamp and designed the first stamp. In 1934, the Migratory Bird Hunting Stamp Act was established to sell stamps to raise money to acquire or lease areas to be managed as waterfowl refuges and sanctuaries.

In 1985, the State of Alaska established a state Waterfowl Conservation Stamp Program, reserving all revenues from the sale of stamps and art prints for conservation and enhancement of waterfowl, protection and acquisition of wetland habitats, and other projects that benefit waterfowl. The State stamp revenues have been used to construct pond and island complexes near Anchorage and Fairbanks. They have provided safe, new habitat for nesting ducks, transplanted Canada geese to Kodiak where they had never occurred, acquired habitat in the Matanuska-Susitna Valley, and payed much of the cost of producing this curriculum.

The annual federal and state stamp designs are selected by means of an art contest or artist competition. Any artist can enter the federal contest by submitting a 5 x 7-inch design of any waterfowl species and paying an entry fee. They may submit a design of the waterfowl species chosen as the subject for that year to enter the state contest. Winning entries are chosen in each case by a panel of art and waterfowl experts. Since 1985, the emperor goose, Steller's eider, spectacled eider, trumpeter swan, and goldeneye have been featured on Alaska state stamps and prints.

Collecting duck stamps and prints is a fun hobby enjoyed by many. They are an investment, and they increase in value over the years because only limited numbers are printed each year.

For more information, read the brochure "The Duck Stamp Story."

Materials

- "The Duck Stamp Story" film (optional)
- art material
- field guides or books with color pictures of birds

Procedure

1. Show the film "The Duck Stamp Story," if available. Either show your students a duck stamp or print (federal stamps can be purchased at any post office; state stamps can be purchased from hunting or fishing license vendors) or ask them if they have ever seen a duck stamp (students older than 16 are required to purchase them if they hunt waterfowl) or print. Discuss why duck stamps or prints are sold. Ask them how money from the sales could be used to help waterfowl (to provide habitat).

2. Explain that both the federal government and the Alaska Department of Fish and Game hold art contests or artist competitions each year to select the design for Duck Stamps. Their art project will be to draw or paint a bird in a wetland habitat and to design a message about what humans can do to help birds that live in wetlands. Depending on the variety of pictures you can provide for reference, either the class can vote on the bird they want on their stamp, you can choose a single bird species which could be the current subject of the state competition, or the students can each choose whichever bird they want to draw or paint.

Extensions

1. The class can vote to select a winning picture. They could make copies of the winning picture and sell them in the community to raise money for bird guides, equipment for field trips, or other projects related to birds or wetlands.

2. The class can promote the sale of duck stamps in the community by using their art projects as posters or by taping public service announcements for local radio or television stations.

3. The class can view the video "The Beautiful Collectible Duck Stamp, 1989-1990."

GLOSSARY

adaptation: a trait that improves a plant or animal's ability to live in a particular environment.

aquatic: lives in water.

bird banding: means of marking birds with bands to obtain data about their flights, migration, and habits.

bog: a peat-forming ecosystem influenced solely by water which falls directly on to it as rain or snow and generally dominated by sphagnum moss.

breeding ground: a land area occupied by migratory birds during the nesting season.

carnivore: a meat-eater.

carrying capacity: the total number of any species that a given area of habitat will support at any given time; the ability of a given unit of habitat to supply food, water, cover or shelter, and necessary space to a wildlife species.

community: all the plants and animals in a particular habitat that are bound together by food chains or other interrelationships.

condensation: water changes from a gas to a liquid form.

conservation: the use of natural resources in a way that assures their continuing availability.

consumer: a living thing that gets energy (food) by eating other living or dead things.

detritivore: a living thing that eats dead things and waste, also called a decomposer.

ecosystem: all living things and their non-living surroundings in a specific area.

emergent: plants that grow in water but have leaves and flowers above the surface.

endangered: an "endangered" species is one which is in danger of extinction throughout all or a significant portion of its range.

estuary: where saltwater and freshwater meet, the water is brackish.

evaporation: water changes from a liquid to a gas form.

flyways: general routes of travel used by birds when migrating between breeding and wintering grounds. For geese and ducks, there are four major flyways in the United States: Atlantic, Mississippi, Central, and Pacific. The actual migratory routes of individual bird species may vary from these general flyway patterns.

food: energy and minerals in a form living things can use.

food chain: the path of energy and minerals from the non-living environment through producers and consumers back to the non-living environment.

food web: all the interconnected food chains within a particular ecosystem.

habitat: the place where an animal lives that provides food, water, shelter, and space in the proper arrangement.

herbivore: an animal that eats plants.

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lagoon: a shallow body of water separated from the sea by sand bars.

management: as related to wildlife, the application of scientific knowledge and technical skills to protect, preserve, conserve, limit, enhance, or extend the value of wildlife and habitat.

marsh: an area periodically wet or continually flooded, but non-peat forming, composed of sedges, rushes, marestail and other soft-stemmed plants.

metamorphosis: change of body form during growth.

migration: seasonal or periodic movement between breeding and wintering grounds. Bird migration varies among species in terms of destinations, time and duration. Generally migration is accomplished to use better feeding areas.

nonrenewable resource: nonliving resources such as rocks and minerals, resources which do not regenerate themselves; substances such as petroleum, coal, copper, and gold which, once used, cannot be replaced (at least not in this geological age).

permafrost: perennially frozen ground that may or may not contain ice.

photosynthesis: the way that plants and algae change sunlight, water, and carbon dioxide into food.

pollution: harmful substances deposited in the air, water, or land which result in adverse changes to their quality.

population: the number of particular species in a defined area.

precipitation: rain, snow, sleet, hail, ice fog, or any other form of water falling to the ground.

predator: an animal that kills and eats other animals (prey).

prey: animals that are killed and eaten by other animals (predators).

producer: any living thing that makes it own food.

renewable resource: living resources, such as plants and animals, which have the capacity to renew themselves when conditions for survival are favorable.

threatened: a "threatened" species is one that is likely to become endangered because of a decline in its numbers.

water cycle: the continuous circulation of water in systems throughout the planet.

wetland: any land area that tends to be regularly wet or flooded during part of the year and has plants that prefer wet soil.

RESOURCES

National Wildlife Refuge System. Department of the Interior, U.S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, Alaska 99503. Pamphlet describing the nation's refuge system. Cost: free.

The Duck Stamp Story. Department of the Interior, U.S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, Alaska 99503. Pamphlet describing the federal duck stamp program. Cost: free.

America's Endangered Wetlands. Department of the Interior, U.S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, Alaska 99503. Pamphlet describing wetlands conservation. Cost: free.

Ducks at a Distance, A Waterfowl Identification Guide. Alaska Natural History Association, 250 Cushman Street, Suite 1A, Fairbanks, Alaska 99701. Cost: $1.00.

Ducks Get Sick, Too! Department of the Interior, U.S. Fish and Wildlife Service, National Wildlife Health Research Center, 6006 Schroeder Road, Madison, Wisconsin 53711. Booklet describing waterfowl diseases. Cost: free.

Lead Poisoning In Waterfowl. Department of the Interior, U.S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, Alaska 99503. Pamphlet describing the effects of lead shot ingestion on waterfowl. Cost: free.

How to Obtain Aerial Photographs. Department of the Interior, U.S. Geological Survey, 222 W. Seventh Avenue, Anchorage, Alaska 99503. Ordering information for maps and aerial photos. Cost: free.

Understanding Color Infrared Photographs. Department of the Interior, U.S. Geological Survey, 222 W. Seventh Avenue, Anchorage, Alaska 99503. How infrared satellite photos are made. Cost: free.

America's Wetlands, Our Vital Link Between Land and Water. Environmental Protection Agency, Office of Wetlands Protection, Office of Water, Washington, D.C. 20460. Booklet describing wetlands protection policy. Cost: $1.25.

Pacific Estuaries. (Videotape) Ducks Unlimited Canada. Available from Department of the Interior, U.S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, Alaska 99503. Cost: free on loan.

Wild Heritage — Geese in Alaska. (Videotape) Department of the Interior, U.S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, Alaska 99503. Videotape showing the natural history of Alaska's geese. Cost: free on loan.

The Beautiful Collectible Duck Stamp. (Videotape) Department of the Interior, U.S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, Alaska 99503. Videotape showing the process of selecting and producing federal duck stamps. Cost: free on loan.

Waterfowl for the Future (The North American Wildlife Management Plan.) (Videotape) Department of the Interior, U.S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, Alaska 99503. Cost: free on loan.

Wetlands in Crisis. (Videotape) Department of the Interior, U.S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, Alaska 99503. Cost: free on loan.

Status of Ducks — July 1989. (Videotape) Department of the Interior, U.S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, Alaska 99503. Cost: free on loan.

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